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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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FRIDAY, NOVEMBER 15, 1907.

The Stahlwerks-Verband, the association which fixes prices and controls the sale of about 95 per cent. of the product of the steel works in Germany, in answer, apparently, to charges that it is using its power to maintain monopoly prices, says that while it has concluded contracts with the State Railroads to supply rails at 120 marks per kilometric ton (\$29.05 per 2 240 lbs.) and ties at 111 marks, for the next three years, this is only \$1.90 per ton more for rails and \$1.43 more for ties than in 1904, which is not nearly so much as the increase in wages and raw materials. It has sold 20,000 tons to Japan and 16,000 to Holland at prices higher than the above. Meanwhile rails cost \$32.50 to \$33 per ton in England; the Belgian State Railroads recently contracted to pay \$31.19 to Belgian works; and the Austrian State Railroads are paying the Austrian works \$36.82 per ton.

These parlous times in railroad financing bring in some singular situations—one of them just revealed in the case of the New York, New Haven & Hartford Railroad. That corporation's board of directors some months ago voted to issue about \$35,000,000 of new stock at \$125 a share to its shareholders and its convertible debenture holders, subject to ratification of the plan by the stockholders at the annual meeting on Oct. 30, 1907; and that recommendation, usually in such cases final, definite and antedating a fact, was published in the annual report of the corporation. On the strength of it a considerable number of shareholders sold their new stock rights to be delivered "when, as and if issued." Suddenly during the panic period the stock fell to a point which made the issue inadvisable and it has been shifted by the directorate into an issue of \$40,000,000 new 6 per cent. convertible debentures put out at par. Where does such a change leave the original "personal" contracts in which, say, A sold his rights to B a broker, and B sold the same rights to C, a customer. The New Haven company is obviously not responsible legally, whether or not, morally, as it merely made a recommendation which the stockholders might or might not approve, though in fact they did so and gave the directors permission to issue, should they see fit, an even larger number of shares than had been recommended. But how stand legally the private contracts of A, B and C, the interests of whom vary according as the market values of the rights may be higher or lower? Are the contracts vitiated by the change of the stock issue to a debenture issue? Are the contracts at the contractors' risks and, if so, what are the legal scope and limitations of those risks? And would the courts decide such contracts a mere "gamble" and therefore

invalid? In not a few cases nowadays "rights" are, as one may say, sold under similar conditions and by contracts based on good faith and resting on official announcement. The legal status of contracts of the sort as fixed by an authoritative finding of the courts would have a moral as well as a material significance.

The railroad superintendent must see that the discipline of enginemen is well maintained, in spite of anything or everything tending to impair it, instead of asking that signals or signal practices or rules be so designed or arranged as to make discipline easy. This would seem to be the lesson of the increasing use of overlaps and automatic stops. One time-honored argument against these two adjuncts is that they make an engineman less watchful of the visual signals because they assure him that watchfulness is unnecessary (as with an automatic stop) or less necessary (as with the overlap). To tell him to stop at a place where he knows that there will be no danger in keeping on is like crying "wolf" when no wolf is near, which puts in contempt the one who cries. But whatever there may be in our theories, practice is changing. The New York Central has had 800-ft. overlaps in its Park avenue tunnel, New York City, for over four years. It has now established longer ones throughout its electric zone, 10 or 12 miles of very busy four-track railroad, which will be increased to three times that mileage. The New York subway has had automatic stops in use for three years, and the officers believe them to be a useful, important and satisfactory safeguard. The same arrangement is in use on the Boston Elevated, and has been installed on the Philadelphia Rapid Transit lines. The Philadelphia & Western has the overlap, with signal arrangements similar to those on the New York Central just mentioned; and the railroad under the Hudson River, between Jersey City and New York, to be opened within a month or two, will have a similar arrangement. Many roads whose lines are neither elevated nor underground seem to be showing increased favor to new devices, such as torpedo machines, cab signals and automatic stops, although, according to the theory, the use of such things must result in weakening discipline. And the roads thus encourage inventors, while yet the inventors' devices are designed and operated according to the objectionable plan of acting to indicate stop, and remaining inactive to indicate proceed. The only thing to do, under these new conditions, of course, is to see that enginemen do stop at stop signals. Theirs not to reason why. Surprise checking will do it. Surprise checking seems to be becoming more

general, and some of the roads on which it is practised allow their press agents to use the records as an advertising text. If those roads need it to prevent collisions, roads with overlaps would seem to need it to restore to their discipline the vigor which the overlaps have taken out of it. Possibly we may wake up some morning and find our discipline reformed. It is true that the motive for introducing the overlap has been the same as that which has retained the flagman and his torpedoes; and that in thus continuing to sit on two stools, we must look sharp that we do not fall to the ground. There remains, however, this important difference, that with the overlap we have a stool which can be watched and can be rationally managed. The flagman, however, defies all discipline, and the flagging rules not only defy systematic treatment, but are absolutely inconsistent with the short time interval which is necessary to the economical use of a railroad which carries a large passenger traffic.

WHEEL PRESSURES ON CURVES.

In the *Railroad Gazette*, Sept. 20, 1907, George L. Fowler reported the results of some tests made with a special track dynamometer which registered the actual pressures against the outside rail exerted by the flanges of the wheels of a consolidation locomotive when running around a $4\frac{1}{2}$ deg. curve. Through the courtesy of the Schoen Steel Wheel Co. we reprint elsewhere in this issue a chapter from a forthcoming book by Mr. Fowler, which gives an account of the complete series of experiments made with this instrument to determine primarily the lateral thrusts exerted by the wheels under loaded cars. The experiments were made as nearly as possible under ordinary running conditions and covered a fairly wide range of moderate speeds. They were not carried far enough to obtain complete data from which a general formula could be derived which would take into account weight, wheel base, speed, curvature and superelevation. Nevertheless interesting conclusions have been drawn as to the effect of some of these factors, which seem to be supported by the records of the dynamometer.

The commonly accepted theory of the relative pressures exerted by the four outside wheels of a double truck car is corroborated by the average pressures recorded at all speeds. The front wheel of the first truck exerts the greatest pressure; the front wheel of the second truck is next in order, followed by the rear wheel of the first truck and the rear wheel of the second truck. The front truck exerts approximately 60 per cent. of the pressure required to turn the car around the curve. There are, of course, wide variations in the pressures, but in general when either wheel on a truck exerts an excessively high pressure, the other wheel exerts a correspondingly lower pressure.

The effect of speed is given by the tentative formula $T=333V-800$, but this holds good only between 7 and 16 miles an hour, where a series of nine records lie in approximately a straight line. Inasmuch as these records represent less than 30 per cent. of the total, not much reliance can be placed on an equation derived from them. The fact that the thrust varies directly with the speed and not with the square of the speed is explained by the fact that the curve was super-elevated for a speed of 36 miles an hour and hence at the low speeds at which the pressures were recorded, centrifugal force was more than balanced by the super-elevation. The force required to deflect the car from a tangent in rounding the curve varies directly as the rate of deflection or, in other words, as the velocity, and it is this force which is exerted between the wheels and rail. However much the exact form of the equation given is criticized, it must be remembered that it gives values which are conservatively low and on the safe side for comparing the relative factors of safety of wheels.

The relation of weight to thrust cannot be worked out from the data at hand because all of the experiments were made with one weight of car. It is probable, however, that the thrust varies directly as the weight, if it is true that the only forces acting are those tending to deflect the car from the tangent. Similarly, the thrust would probably vary inversely as the radius of curvature at speeds below that for which the outer rail was elevated. It is evident that only a long and complete series of experiments would establish the exact relation between all of these factors, if such a relation exists. The effects of impact and other forces due to slight variations or imperfections of the cars and track may be so great as to prevent the formulating of a general equation which would be anything more than a rough approximation.

As a result of his experiments, Mr. Fowler estimates the maximum lateral thrust of car wheels in ordinary service to be 30,000

lbs. at 45 miles an hour. The tests of breaking strength of cast iron wheel flanges, made in 1905 by Prof. Goss, gave a minimum of 47,750 lbs., a maximum of 109,900 lbs., and an average of 80,440 lbs. This would indicate an average factor of safety of 2.5 and a minimum of 1.5 for new wheels. Wear and brake-shoe heating would undoubtedly reduce these values, possibly as much as 25 per cent. It is not to be wondered at, in view of these facts, that flange breakages under high capacity cars have been so frequent.

MAINTAINING LOCOMOTIVE POWER BY A STANDARD OF EFFICIENCY

A method designed to systematize and regulate the shopping of locomotives in order to maintain a certain standard condition of power is described elsewhere in this issue. Entire novelty is not claimed for the ideas set forth, although certain features, including the plan for recording graphically the condition of power, as illustrated in two of the figures shown, are new so far as we know. Neither are radical or revolutionary results, evidenced by an immediate marked improvement in the condition of power, expected to follow its application to a division. It is being introduced gradually on the road with which the author of the article is connected, the Atchison, Topeka & Santa Fe, without any desire to upset suddenly the existing order of things, it being considered that the fact that the divisions to which it has been applied know they are under this constant surveillance and that careful comparative graphical records are being kept at headquarters, is of itself a sufficient advantage to make it worth while, as they are thus spurred to make as good a showing as possible.

Establishing a standard, as described, places the condition of power on an efficiency basis; the average of all of the engines on a division must therefore be 100. If it is less than this they are dropping back, while if it exceeds this they are in highly satisfactory condition. It follows then that in order to maintain the standard, a certain percentage of the engines must be shopped each month. The article explains how this percentage is determined, the resulting figure being the "standard per cent. to be overhauled" forming part of the graphical record of condition of power accompanying the article.

The limit for light repairs is \$500; therefore if the cost of work on an engine exceeds this amount, the engine loses its mileage and must start afresh. Naturally, where the figure for cost of work runs close to this dividing line, the master mechanic will try to keep under the limit in order to save his mileage. Some juggling of figures will doubtless result in such instances, but granted that it does, it is regarded as a hopeful feature rather than the reverse, indicating a striving after a good record.

As an educational feature, and for application where conditions warrant, the general scheme has much to commend. The practical motive power man might object that the life insurance comparison used in the article is hardly a true one from the power standpoint, since the latter must include, not "selected risks," but all locomotives which happen to fall to the lot of a division, regardless of age, inherent weaknesses and other physical disabilities; therefore, that the matter of average condition of such a group of engines and the laws for its care are hardly susceptible of the exact mathematical treatment of life insurance, claimed near the end of the article. But it must be borne in mind that the outline given is made up in part of theoretical considerations and must be examined from this standpoint. Of course, all sorts of complicating factors can be enumerated which will militate against the practical application of any scheme having in view the objects of this one. Conditions are seldom if ever the same on any two roads, and are constantly changing on every road, influenced by traffic fluctuations, labor conditions, changes of policy, and other such forceful elements.

Transferring locomotives between divisions is another disturbing factor, especially where the operating conditions differ greatly. The two divisions may be totally unlike. One may be single track, on which a freight engine starts and stops its train 20 or 30 times in a trip, while the other may be double track, and engines of the same class and in the same service will stop only for water and make the same mileage in one-half the time. There is no reason, however, why the plan cannot be adjusted to suit such conditions.

The system is capable of being extended in a number of ways. One, which has been partially worked out in theory, is the adjustment of repair activity to traffic needs. To do this the periods of light and heavy tonnage on each division must be studied. By plotting these for a series of years it is possible to say well in advance, in a general way, when the engines on a particular division

will be needed for heavy service. In preparation for this demand the condition of power would need to be brought above standard, so that during the period of heavy movement it would not fall too far below the normal level, and a balance thus be maintained.

SOME PROGRESS TOWARD GETTING BETTER RAILS.

At the October meeting of the American Railway Association the rail committee reported unanimity on all except two points in the proposed specifications. But these exceptions—the percentage of phosphorus and the percentage of discard—are of high importance, and two members, Mr. Isaacs, of the Southern Pacific, and Mr. Richards, of the Pennsylvania, submitted minority reports. Because of these differences of opinion the report was not received for discussion by the association, but was returned to the rail committee with instructions to continue its work, with authority to make such expenditure as may be required to secure the assistance of a number of experts of the highest standing.

Although it comes as a severe disappointment to those who hoped for an immediate reformation of thoroughly bad practice in making rails that break and wear out too soon, nevertheless the committee has accomplished much in having agreed among themselves, and having secured assurance of acceptance by the rail makers, on nearly all the propositions involved in making safe rails. If the railroads will insist on observance of these agreed clauses in the specifications in their rail orders for 1908, it will save some lives and some money. They have a basis for requiring that the ingots be kept vertical until solidified; that no bled ingots be used; that "at the final pass the temperature of the rail will not exceed that which requires a shrinkage allowance at the hot saws, for a 33-ft. rail of 100-lb. section, of $6\frac{7}{16}$ in., and $\frac{1}{16}$ in. less for each 5-lb. decrease of section"; that the drop tests (a 2,000-lb. weight dropped 22 ft. on a 100-lb. rail) shall be made on a sample from each blow of steel; that the process of hot straightening shall leave the rails substantially straight; and that the facilities for the inspectors shall be such as to secure good product.

The recommended adoption of two standard sections, instead of one, for service under differing conditions is a result of the highest importance. The redistribution of the metal in the head and base so as to make a nearly balanced rail, and the reformation of the base so as to reduce the strains developed in cooling, will meet the approval alike of the makers and the users. With these practicable sections, with inspection fully as thorough as can be expressed in words, with competent inspectors and plenty of them, so that the processes can be watched from beginning to end, and with the specified tests rigidly adhered to, good rails can be got by those railroads who can afford to refuse to be baffled. It would be well, too, to mark the rails in such a way that each rail can be identified in relation to its place in the ingot.

There are two plain results so far secured from the agitation of the subject and the work done by the American Society of Civil Engineers, the Maintenance of Way Association, the Society for Testing Materials and the American Railway Association: The absolute necessity for better rails is recognized by all, and the chief executive officers of the railroads and the rail mills are now in closer touch than they ever have been, and they will do their utmost to secure sound material. It is now to be expected that those who buy and those who sell, realizing that a great responsibility rests on them, will treat the subject in a dignified but very thorough fashion.

Concerning the percentage of phosphorus: Mr. Kruttschnitt's supplementary report is so clear that it is a great pity that a construction of the rules of the American Railway Association prevents its publication in these columns. He admits the claim of the manufacturers that there is not enough American ore of such composition as to supply all American railroads with rails with a maximum of .085 phosphorus, but shows that the manufacturers are now filling Canadian and foreign orders from this best quality ore. He justly demands that the manufacturers use this best quality ore, as far as it will go, in supplying American railroads.

The important specification for a fixed percentage of discard from the ingot is far from acceptance. It has been shown by reports and photographs of broken rails to be the overwhelmingly important specification in the present state of the art of making ingots. The manufacturers firmly oppose it, and are technically right in saying that this is a crude and wasteful way of attempting to correct an evil. Although it cannot be denied that a fixed minimum cut of the inferior metal from the top of the ingot is the only pres-

ent known way (after complying with all the other specifications) of improving quality, nevertheless this received final support in the committee of nine from the representatives of the Pennsylvania and the Southern Pacific only. This is, however, a time for suspending judgment. The committee is authorized to employ the best talent in the world, and we may hope for some better solution than an arbitrary rule for this one specification.

Further discussion of this subject is invited.

The fine of \$25,000, which was imposed on the Michigan Central at Toronto, Ont., recently for criminal negligence in connection with an explosion of dynamite in a freight car, killing two persons and injuring many, was based on circumstances which the judge declared made his "blood run cold." A car containing boxes of the explosive, also other freight, was so roughly handled that some of the boxes of dynamite shifted in their places and were found on edge. Besides this, the liquid explosive leaked from the boxes and ran from the floor to the ground, so that while the car was being switched crackling noises were heard. This condition lasted a day or more while the car was moved in two different local freight trains. Even when the conductor finally righted the boxes he did not wash the floor or the running gear on which the liquid had leaked. A suitable placard was tacked to the outside of the car, and this was considered by the Railway Commission a compliance with the law, or at least enough of a compliance so that the commission declined to prosecute the road; but the court (Mr. Justice Riddell) holds that the company was grossly negligent in not instructing its trainmen or taking the special care which was obviously necessary in handling explosives. A common carrier need not accept explosives, but if it does accept them it must take all necessary precautions. A grand jury had exonerated the trainmen, but the judge says that the question of the guilt of those men is not before him in the present case. The railroad company pleaded guilty. It was claimed that the explosive had not been correctly described by the shipper, but the judge does not accept that as an excuse. He deplored the lack of a public officer to watch for such offenses against the law, the evidence convincing him that the bad practice here shown had been of long standing. The amount of the fine was fixed (apparently smaller than otherwise it would have been) after the road had stated that it would have to pay at least \$15,700 in damages, besides settling with other parties who are asking for \$50,000. Justice Riddell finds that no officer or employee of the road (except the trainmen, whose chief fault is ignorance) is within the jurisdiction of the court. If any such officer or employee could be found he would recommend his indictment.

The Railroad Commission of Wisconsin has rescinded an order, issued by it early in September, requiring the Marathon County Railroad, owned by the R. Connor Company, lumbermen, to provide weekly passenger service. The report of the railroad for the period of September 5 to October 22 showed that the entire passenger revenue was \$1.10. Trips were made on Tuesdays of each week. The cost of each trip, including only the wages of the trainmen and the fuel, was \$4 for each trip. The road charged 2 cents a mile, although not required to do so under the Wisconsin 2-cent fare law, which applies only to roads earning more than \$5,000 a year. The Wisconsin commissioners seem to lean toward conservatism. Why didn't they order two trains to be run daily each way, so as to "develop" traffic?

Kansas City Southern.

The Kansas City Southern has had a memorable year. The twelve months ended June 30, 1907, covered a period in which the road not only found itself and secured the most favorable results in its history, but in which the Kansas City Southern led the other railroads of the country in its gains in operating results. This last comparison, of course, is not altogether a fair one, for no large well equipped system had the same opportunity to progress. Two years ago the Kansas City Southern, cheaply built to begin with, had been allowed to run down and rust out. The independent management which took hold in May, 1905, began at once to improve and rehabilitate. These improvements began to show their effect during the past year. This was one reason for the favorable results. Another was the great prosperity of the Southwest, through the heart of which the road runs following roughly the boundary lines between Kansas and Missouri, Indian Territory and Arkansas, and Texas and Louisiana. A third influence, perhaps most important of all, though not so obvious, was the election in June, 1906, of L. F. Loree as chairman of the executive committee. His wide experience in railroad operation was actively used in meeting the problems of the Kansas City Southern.

The road's gross earnings for the year were 20 per cent. larger than those of 1906, yet operating expenses decreased 3 per cent. As a result, net earnings were \$3,700,000, against \$2,000,000 in 1906,

an increase of 83 per cent. Fixed charges were 20 per cent. greater as a result of the larger amount of 5 per cent. negotiable gold notes outstanding, leaving a net income of \$2,450,000, against \$930,000 in 1906, an increase of 163 per cent. The most remarkable feature of this showing is that in a year when railroad expenses generally grew almost as fast or faster than gross earnings, the Kansas City Southern's operating ratio dropped from 73.10 to 58.78 per cent.

The traffic of the road is largely made up of forest, agricultural and mineral products, which move in large quantities in full carloads but at low rates. The largest single article of traffic is lumber, which comes from great tracts of southern pine timber which it is estimated will last for a generation. Large bodies of hard wood timber are also now just beginning to be developed.

The next most important traffic group is agricultural products. Yet south of the Missouri state line, only about 18 per cent. of the land tributary to the road is under cultivation. The lands in Indian Territory and in Kansas are rapidly filling with new settlers and will soon be made much more productive. The principal agricultural tonnage, however, must always come from Kansas City and its tributary agricultural territory. Kansas City is the second primary grain market of the United States. In 1905, of the 358,000,000 bushels of grain produced in its territory, over 66,000,000 bushels centered on Kansas City for trans-shipment. This is the region to which the advantages of the Gulf ports for export over the Atlantic seaboard harbors are greatest. The southbound grain movement from this section is constantly growing and is likely to receive still greater impetus when the Panama canal is built.

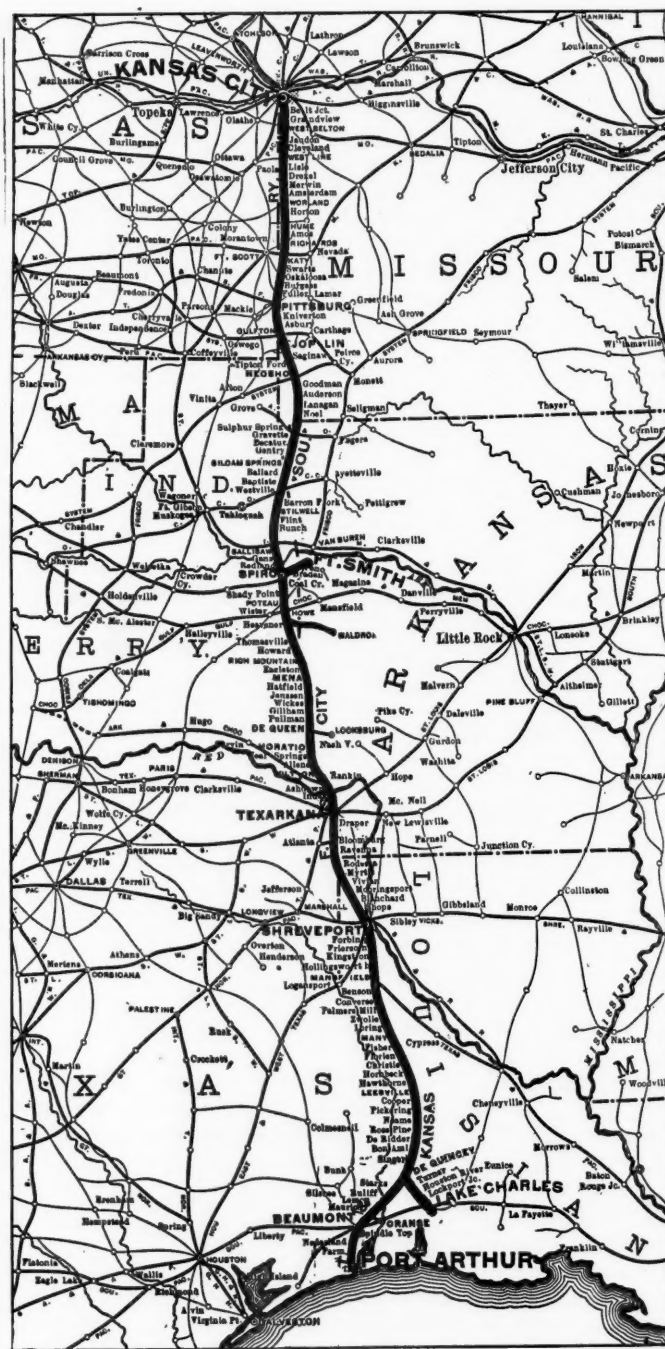
This traffic is at the moment especially valuable to the Kansas City Southern because it tends to balance its traffic. The principal traffic movement has been the lumber tonnage from the southern and central parts of the line, north to the Kansas City gateway. Much of this in the past has been unbalanced traffic resulting in a large southbound empty car movement. The southbound grain movement is highly competitive but, nevertheless, because it is southbound traffic, is especially profitable. When it grows so much that it becomes necessary to load more cars south than north, the margin of profit will be greatly reduced. If it should grow still further so as to necessitate a considerable northbound empty car movement, the profit may be entirely wiped out.

Coal is the third most important article of traffic, though the Kansas City Southern's possibilities of mineral tonnage are, as yet, little developed. The district bounded by the Mississippi river, the Gulf, the Rocky mountains and Canada, is an area 900 miles wide and 1,300 miles long, approximately equal, excluding Russia, Norway and Sweden, to continental Europe. There are in it only three fields of commercial coal. Of these, the Indian Territory-Arkansas field is the most important. The Kansas-Missouri field comes second and the Missouri-Iowa field third. The first is about 30,000 square miles and the second 20,000 square miles in area. The Kansas City Southern crosses both of these two principal coal fields, but for a number of reasons, principally for lack of branch lines, this traffic has not been developed. Coal furnishes only about 18 per cent. of the Kansas City Southern's total tonnage while on comparable railroads it makes up from 40 to 50 per cent. The road's share in this business is so small that in 1906 it carried only 3.2 per cent. of the total output of these two most important fields. Besides these three principal sources of low grade traffic there are the zinc mines in the Joplin district of Missouri and the Pittsburg district of Kansas, the oil fields in southern Kansas and Indian Territory which are now being rapidly developed, and many stone and slate quarries.

These are the principal traffic resources of the railroad. The profits which it can gain from the rich resources of its territory depend on the extent to which it is able to rise to its opportunities. The Kansas City Southern is to-day one of the most striking examples of a railroad which could make money by spending money. It is probable that it could profitably use from \$10,000,000 to \$25,000,000, or from about one-ninth to one-fourth of the sum at which all its properties are carried on its combined balance sheet, in betterments, improvements and extensions. With funds to that extent at its command, a sweeping campaign of improvement could be applied to the whole property, the rich sources of its local territory protected by building branch lines, and an extension to New Orleans, already surveyed, carried out. Barring a severe industrial depression in the Southwest, every one of these expenditures would not only pay a reasonable return on their cost, but would earn profits besides.

In the present state of the investment market it is out of the question to secure any such sums. Nevertheless, the company was fortunate in getting enough money to provide for considerable improvements before railroad securities became unsalable. On April 2, 1906, an issue of \$5,100,000, six-year 5 per cent. notes was underwritten. On June 30, 1907, \$4,806,000 of these were outstanding, from which the Kansas City Southern had received \$4,443,612 as net proceeds. Of this sum \$3,949,537 had been spent; \$3,400,000 for general improvements, the rest for equipment, real estate and

advances to Port Arthur Canal & Dock Company for improvements. Including the \$294,000 notes unissued which will net \$270,950, the unexpended balance of about \$500,000 of the net proceeds earlier received, and the sum of \$263,115 which is the unexpended balance from track and bridge materials taken out of service in the course of improvements and available as a fund for further improvements, the Kansas City Southern had on June 30, 1907, \$766,000 still available as an improvement fund. There was required \$1,780,000 to finish the authorized improvements not completed on that date. It will therefore be necessary to provide \$1,014,000 from surplus earnings from operation. This is to be and can be done. Thus, it is within the power of the road to carry out the first and most important section of the improvement expenditures. This definite statement of the sources of the funds for improvements



Kansas City Southern.

and their application informs the stockholder of exactly what has taken place in this most vital and at the same time uncertain department of a railroad's finances instead of giving him incomplete figures or no figures at all. It takes him into the confidence of the management instead of making it difficult or impossible for him to know the facts.

The improvements now authorized when finished will not make the Kansas City Southern an efficient operating property. They are made up mostly of improvements to freight stations, new sidings, reconstruction of bridges, ballasting, widening embankments and terminal betterments. The next vital need of the road is for grade reduction. The work of investigating such possibilities was vigorously carried on during the year. Thorough examination of the whole territory from Kansas City to the Gulf was made both by reconnaissance and by instrument surveys. It was found that

the grades on the 433 miles from Kansas City to DeQueen, Ark., which is at the southern foot of the Ozark mountains, can be revised to a maximum of one-half of one per cent. and no lower. From DeQueen to Port Arthur, Tex., 353 miles, it is feasible to reduce the grades to three-tenths of one per cent. With the existing volume of traffic, however, it is for the present preferable to plan for a revision on the same basis as on the northern end of the line. At present the road has grades of 1 per cent. or steeper on every operating division. As a result, train operation is most costly, particularly because most of the business, as already described, is low-grade heavy traffic. Grade reduction is vitally important both for this reason and because of the highly competitive nature of the southbound grain traffic from Kansas City to the Gulf. When the line betterments which are planned are carried out, the expenses of moving the traffic are to be cut in half and the export grain business, now profitable, will come to be a source of much larger profit.

The Kansas City Southern is considerably shorter from Kansas City to tidewater than any other railroad under single ownership, and President Edson states that the changing rate conditions, due to legislation and commercial activity, are giving the factor of relative distance more value than heretofore. If the Kansas City Southern can add to its advantage in distance over its competitors, an advantage in grades, its command over the export grain traffic, potentially enormous in volume, will be greatly strengthened. While it is not possible for the company to begin at once all of the grade improvement, arrangements have been made to begin this work on the heavy mountain division of the road between Spiro, Ind. T., and Shreveport, La. This is a territory where the traffic is heaviest and growing most rapidly. This stretch when improved will give a low-grade line for the development of the Arkansas-Indian Territory coal field, and will also greatly reduce the cost of operation.

The next work of this sort which is likely to be undertaken, but which as yet is not authorized or arranged for, is a change of line for 41 miles in the neighborhood of Fort Smith, Ark. The importance of this place as the commercial center of the middle Arkansas valley its situation in the coal and natural gas fields and its rapid growth in population and manufactures, are all arguments for putting it on the main line of the Kansas City Southern. This can be done by building a new line from Stilwell, Ind. T., to Fort Smith, and using the branch from Fort Smith to Spiro to complete the new line, which would be 40.79 miles long, 2.55 miles longer than the present line. In case this were done the old line between Stilwell and Spiro would be abandoned as a through line.

The necessity of carrying out these various betterments of the operated line arises from the character of the Kansas City Southern as a trunk line from the grain producing states to the gulf of Mexico. The road lies surrounded by powerful neighbors and competitors, aggressive in their development. Its profitable future depends on so improving its facilities as to put it in a commanding position for inviting business and economically handling it.

It is fair to attribute the splendid showing of the road during the past year largely to the management. Mr. Loree and President Edson have a record of which they may well be proud. The railroad improved not only in earnings, but in operating efficiency. The most obvious way to increase the efficiency of operation was by reducing grades and curvature but as this relief was not at hand, other means were used. Largely as a result of the weak position which the road occupied in competitive traffic, shippers had been allowed to be slow in handling their cars. This general laxity had a serious effect on the operation of the road, for largely on account of it the average car movement in the first half of 1906 was about 20 miles a day. As a result, freight moved slowly and the road was handicapped as against other railroads. During the last fiscal year more prompt handling by shippers was insisted on. As an immediate result the average car movement was increased in three months to 34 miles a day. The resulting quicker movement of freight attracted southbound traffic. This was the traffic which was especially valuable on account of the back haul. The increase in the revenue trainload from 289 tons to 332 tons, or 15 per cent., came as a result not of using heavier power, but of filling out the southbound trains. The same cause is largely responsible for the increase in the revenue carload from 14 tons to over 15 tons and in making 120,000,000 more ton-miles with a decrease of 22,000 train-miles. Conducting transportation increased only \$31,000 not because the Kansas City Southern did not have to pay larger prices for its materials and labor, but because of these operating economies.

There was a decrease of \$160,000 in cost of maintenance of way and of \$76,000 in maintenance of equipment, but both of these expenditures are to be compared with a year whose expenses included large amounts spent for rehabilitation. Furthermore, as a result of the "bonus" system adopted in the maintenance of way department, which was described in the *Railroad Gazette* of August 2, 1907, in an article describing in detail the methods employed by the management to bring about the results of the year, it is probable that the lower maintenance of way figure represents al-

most as much actual improvement of the line. The unit maintenance charges for the two years were as follows:

	1907.	1906.
Maintenance of way per mile.....	1,005	1,201
Repairs and renewals per locomotive	2,713	2,850
Repairs and renewals per passenger car	740	863
Repairs and renewals per freight car	50	65

The amount spent on freight car repairs seems too small for a year when cost of materials increased but there is no doubt that the freight cars are generally in good shape, which is quite the opposite of their condition on June 30, 1905.

No table of commodities carried is included in the report probably because in the case of this road such information would be of great value to competitors. It is, therefore, not possible to analyze the traffic except by the three large groups already described.

The Arkansas Western, which runs from Heavener, Ind. T., east to Waldron, Ark., 33 miles, is owned by the Kansas City Southern but operated separately. It had gross earnings of \$38,000, against \$75,000 in 1906. It is shown on the accompanying map.

The Kansas City Southern is an unusually interesting railroad because it is a trunk line, independent, and small and compact enough so that its operations stand out clearly instead of in totals so large that the individual tendencies are obscured. The road has, largely from the development of its local resources, reached a self-supporting position. Its future success depends largely on the amount of money which it can command to improve its property and extend its influence. It has a magnificent opportunity. With a return to normal conditions in the security market this opportunity is not likely to be wasted.

The following table summarizes the operating results:

	1907.	1906.
Mileage worked	816	816
Passenger earnings	\$1,343,354	\$945,208
Freight earnings	7,018,633	5,958,153
Gross earnings	9,084,332	7,568,332
Maint. way and structures	819,859	980,104
Maint. of equipment	1,108,521	1,184,080
Conducting transportation	2,885,789	2,854,696
Operating expenses	5,339,519	5,532,275
Net earnings	3,744,813	2,036,057
Fixed charges	1,367,608	1,131,900
Net income	2,455,339	933,055
Dividends	840,000	
Year's surplus	1,615,339	933,055

Louisville & Nashville.

President Milton H. Smith, of the Louisville & Nashville, evidently does not consider an annual report to stockholders a desirable publicity medium for his opinions, which are by no means mild, on the subject of railroad legislation. The Louisville & Nashville, though hard-pressed by legislation, makes no reference, directly or indirectly, to the subject, in the report for the year ended June 30, 1907. Yet in Alabama, in which it has an especially large mileage, it is at the moment facing a special session of the legislature called largely because of its refusal to acquiesce as the other railroads of the state had done in the reduced rates passed by the legislature at its last regular session. In connection with this special call of Governor Comer of Alabama, President Smith is making his opinions known at some length. The following quotation is a fair summary of his position:

"Will the citizens of Georgia or other states or other countries invest their savings, on which they may desire to receive a satisfactory return, to create railroads in a state or country where the remuneration received for the transportation of persons and property is fixed by the agents of the state, without the state's assuming any responsibility for the result, and where, in addition to fixing the rates and exacting onerous taxes, the state enacts laws regulating the conduct of business and the relations between the carrier and its patrons in a manner that, if enforced, will greatly harm and probably financially embarrass the carrier?"

The sphere of influence of the Louisville & Nashville lies between a line drawn from Cleveland, Ohio, south to Jacksonville, Fla., and another line drawn from St. Louis, Mo., south to New Orleans, La., the whole bounded by Chicago on the north and the Gulf on the south. The bulk of its lines lie in an even narrower north and south belt, bounded on the east by a line from Toledo south to Cedar Keys, Fla., and on the west by a line from Chicago south to Mobile, Ala. It owns or controls, directly or indirectly, 6,891 miles of line, of which 4,306 miles are directly operated. Its own northern terminals are at Cincinnati, Louisville, Evansville and St. Louis, but jointly with the Southern Railway it controls the Chicago, Indianapolis & Louisville, which gives both of the southern roads a Chicago connection. The annual report of this road is reviewed in another column. The Louisville & Nashville itself owns the majority of stock of the Louisville, Henderson & St. Louis, 218 miles, which runs from Louisville west to Evansville, and of the Nashville, Chattanooga & St. Louis, 1,230 miles, which runs from three terminals on the Mississippi river southeast through Chattanooga to Atlanta. With the Atlantic Coast Line, of which it is itself a subsidiary, it leases the Georgia Railroad and its dependencies, the Atlanta & West Point and the Western of Alabama, these three roads together forming a line from Selma and Montgomery, Ala., east through At-

Ianta to Augusta, Ga., with branches, 571 miles. The map published herewith, even though it does not bring out the subsidiary and controlled roads, gives an indication of the widespread influence of the road in its particular territory. With the other lines brought out in full relief, this showing would be even more striking.

Last year's operations were affected by the influences of higher costs and congested traffic, which seem to have been stronger in the South than in any other part of the country. The Louisville & Nashville also suffered especially from the heavy damages of the Gulf storm of September, 1906. However, the company was not as hard hit by the other difficulties as the Southern Railway, for instance, because it was better prepared to meet the rush of traffic. It has more double track (though the report gives no information on this point) than the Southern, and also more and better equipment. This superiority is due to large betterment expenditures out of earnings during recent years.

Gross earnings were \$48,200,000, against \$43,000,000 in 1906, an increase of \$5,200,000, or 12 per cent., but straight operating expenses rose almost \$42,000,000, or 16 per cent., leaving net earnings of \$16,100,000, against \$15,000,000 in 1906. The increase in earnings came from both the freight and the passenger departments. Freight earnings increased 11 per cent., and passenger earnings 16 per cent. The operating ratio was 74 per cent., against 72 per cent. in 1906.

The large increase in operating expenses was in conducting transportation. The operation branch of this account in itself was \$1,400,000 larger than the conducting transportation expense for both operation and traffic in 1906. Owing to a rearrangement of the conducting transportation expenses, including the separation of the account into the two separate branches, accurate comparisons cannot be made of most of the separate accounts, but where the same accounts appear in both years the increased cost is very noticeable. Among the individual accounts which can be thus compared are engineers and firemen; fuel, water supply, oil and waste for locomotives; switchmen, flagmen and watchmen; telegraph expenses; clearing wrecks; loss and damage-freight; damage to stock; injuries to persons, and stationery and printing, all of which largely increased. Under general expenses there was a large increase in the salaries of clerks and attendants. Thus the ordinary, necessary non-productive expenditures cost a great deal more than in the previous year.

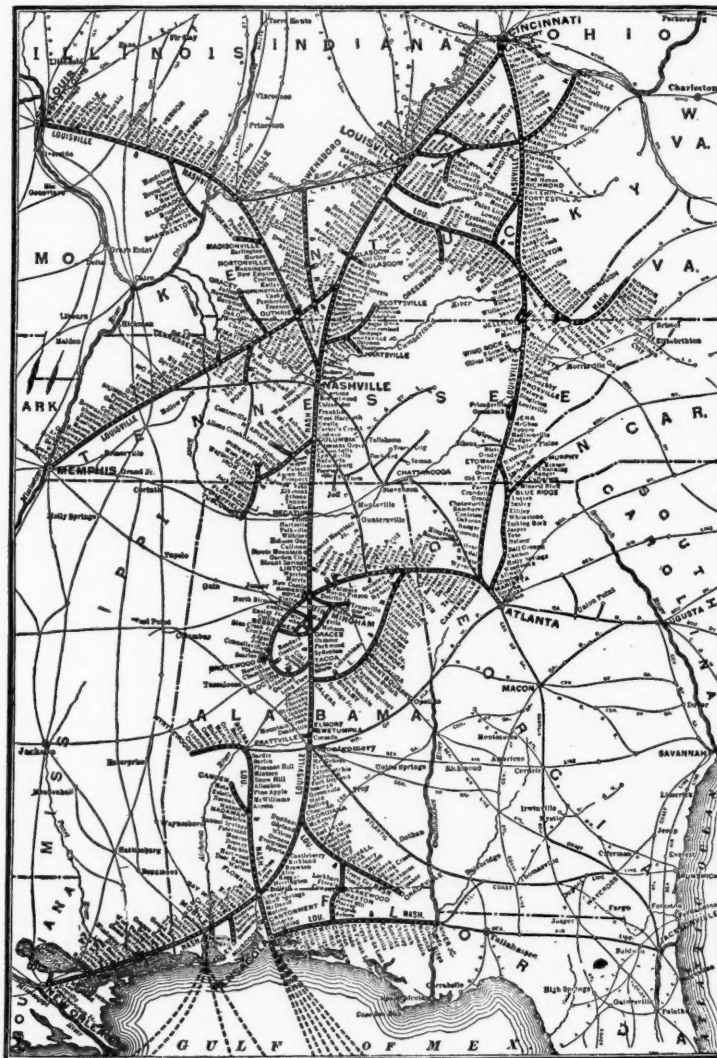
Like the Lake Shore & Michigan Southern, the Louisville & Nashville includes in its maintenance operating expense accounts money spent for betterments and improvements. Including such improvement costs, the total amount spent on maintenance of way was 23 per cent. larger than in 1906. In 1906 it was 15 per cent. larger than in 1905. The part of this cost which went for improvements was \$2,545,988, against \$1,785,196 in 1906 and \$1,574,428 in 1905. Including these, maintenance of way cost \$1,873 per mile, against \$1,583 in 1906 and \$1,490 in 1905. Straight maintenance of way, excluding betterments, cost \$1,282 last year against \$1,150 in 1906 and \$1,079 in 1905.

Equipment expenditures are described in great detail. Repairs cost \$3,080 per locomotive, against \$3,844 in 1906; repairs and renewals, \$3,188, against \$4,031 in 1906. Besides this \$337,500 was charged to operating expenses under improvement account for new locomotives, \$216,000 to the capital accounts, "improvements and betterments" and "South & North Alabama Railroad" and \$895,000 to cost of road and equipment for the same purpose. There were 865 locomotives owned on June 30, 1907, against 745 a year earlier. Repairs cost \$924 per passenger car, against \$1,003 in 1906. Including renewals, the passenger-car cost was \$1,004, against \$1,039 in 1906. At the same time there was \$57,560 charged to improvement account and \$68,000 to cost of road and equipment for new passenger cars. Freight car repairs cost \$67 per car, against \$56 in 1906. Repairs and renewals were \$91 per freight car, against \$761 in 1906. At the same time \$656,520 was charged to improvement account and \$1,400,000 to cost of road and equipment for new freight cars. These are very liberal charges. When a road spends as much as this on each unit of its equipment it is not easy to make careful comparisons between different years. The decrease in locomotive repairs, however, follows a year when this expense increased over 50 per cent., due to a number of special causes, including the repairing of old locomotives taken over with the Atlanta, Knoxville & Northern and repairs postponed during the time of removal from the old to the new shops at South Louisville. The increase in freight car repairs, on the other hand, reflects the greatly increased cost of materials and labor.

During the year reduction of grades between Saxton, Ky., and Corbin, on the Cincinnati-Atlanta line, was finished and work begun on grade reduction and double-tracking from Corbin north to Livingston. When finished, this will give a double track for 35 miles north of Corbin, with a maximum grade from Saxton north to Sinks, 61 miles, of 0.65 per cent., compensated in both directions, except for one southbound pusher grade four miles long.

In order to provide funds for finishing construction work and improvements under way and authorized, the company in February issued \$6,500,000 three-year 5 per cent. notes, which were sold at 95½, a net return to the company of \$6,207,500. As a result, the

Louisville & Nashville is to-day in a better position, from the standpoint of cash resources, than many other railroads. Within the past few years it has come to be one of the strongest of the country's railroads. This is indicated by the fact that at the extreme low prices now prevailing Louisville & Nashville stock sells little lower than New York Central. Both are 6 per cent. stocks, but the New York Central has a long record of dividend payments behind it and tremendous equities in controlled companies, while the Louisville &



Louisville & Nashville.

Nashville paid no dividends in the five years from 1894 to 1898 and is a minority stock.

The following table shows the income results of the last two years:

	1907.	1906.
Mileage worked	4,306	4,131
Passenger earnings	\$10,417,470	\$8,985,216
Freight earnings	35,235,787	31,536,207
Mail earnings	883,434	907,339
Express earnings	1,078,601	958,886
Gross earnings	48,263,945	43,008,996
Maint. way and structures	5,519,910	4,752,501
Maint. of equipment	7,628,006	6,625,706
Conducting transportation	17,972,348	15,639,420
Operating expenses	32,153,711	27,982,111
Net earnings	16,110,235	15,026,886
Net income	10,078,114	9,299,728
Dividends	3,600,000	3,600,000
Improvements:		
Maintenance of way	2,545,988	1,785,196
Maintenance of equipment	1,081,604	1,166,157
Year's surplus	2,850,522	2,748,375

Wabash.

Last year was the second year in which the present management of the Wabash, with Frederic A. Delano as President and Henry Miller as Vice-President and General Manager, was in charge of the road. The 1906 report told of the introduction of many changes in organization and operation. Last year these changes had a chance to show their effect. In general it was a very favorable one.

The handicaps of the road may be considered first. It lies in highly competitive territory surrounded by competitors stronger in traffic advantages and financial resources. As a result it receives low freight and passenger rates. To get a satisfactory profit from such competitive business a railroad needs to have facilities as nearly perfect as possible. The Wabash has lacked much in this respect

and still lacks a great deal. The bright promises of its future cannot be carried out until its general financial plan is successful. This was delayed by opposition of some of the holders of the debenture B bonds, but has since been postponed far more decidedly by the depression in the financial markets. How hard this has hit the financial plan of the Wabash is shown by the price of 40 at which the new 4 per cent. consolidated mortgage bonds, of which a few have been put out, are selling.

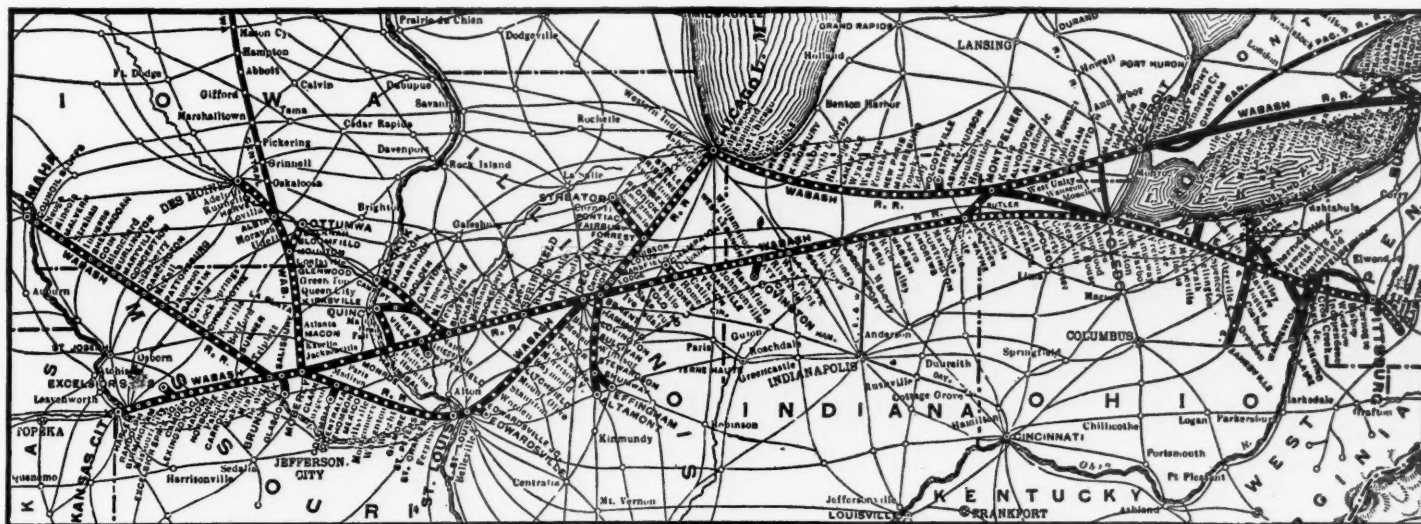
In passenger earnings the Wabash is especially hard pressed by the competition of the most highly developed system of interurban lines in the country. The effect is clearly shown in a reduction last year of the number of passengers carried, but an increase in the number of passenger miles. President Delano frankly says that the electric lines are being used more extensively for the shorter trips, leaving to the steam railroads only the long haul business. The Wabash is also in particular a sufferer from 2-cent fare laws which are now in effect in Ohio, Iowa, Indiana, Illinois and Missouri. Except in Ohio the new laws have not had time to fully show their effect. Passenger earnings showed only a slight increase last year and are still more than \$2,000,000 less than in 1905, which was the year of the heaviest traffic to and from the World's Fair at St. Louis.

The work of the past year has been toward the improvement of the property to the extent of funds available and the attraction of traffic by more efficient operating methods. The report of the Traffic Manager which was included in the 1906 annual report is not published this year, so that changes in traffic methods can be seen only indirectly. The train and mileage statistics are given in exceptional detail. One important feature closely associated with the growth of traffic, however, is not included—the average distance haul of each passenger and each ton of freight, nor is any list of

10 large switching engines which will be important in cheapening the cost of operation.

Arrangements have been made for the use of about 56 miles of track of other companies on the St. Louis-Kansas City line as new double track. The Chicago & Alton track between Mexico, Mo., and Clark, 26 miles, and the Wabash track between these points are to be operated as double track. A similar arrangement has been made with the Santa Fe between Carleton, Mo., and Camden, 30 miles. A double track arrangement was already in force with the Burlington between Birmingham, Mo., and Harlem, 10 miles, so that by the small investment necessary for new crossovers and interlocking at junctions, the Wabash will have the use of 66 miles of double track between St. Louis and Kansas City. As a further operating economy, on July 1, 1907, the division headquarters of the Detroit-Chicago line was moved from Ashley, Ind., to Montpelier, Ohio, thus doing away with one of two division points which were located within 24 miles of each other.

Gross earnings were \$27,400,000, an increase of \$2,400,000 and the largest in the history of the road. Operating expenses increased \$2,000,000, leaving net earnings larger by \$300,000 than in the previous year. This is after eliminating the amounts shown in the maintenance accounts as spent for improvements in the two years. Besides the larger costs of labor and material the operating expenses were increased by strengthening bridges and turntables, raising coal chutes and water tanks, extending engine houses for larger engines and increasing siding accommodations for the resulting heavier trains. The use of metal instead of wood in renewing box car roofs and draft attachments of freight cars and the equipping of freight cars with air brakes also added to the operating costs. From the net income of the year a 6 per cent. dividend was paid on the debenture A bonds and a 1 per cent. dividend on the debenture



Wabash Railroad.

tonnage by commodities included in the report. Probably these facts are not made public for the same reason as in the case of the Kansas City Southern, reviewed in another column; because this information would be of considerable value to competitors.

Among the more important measures which have been taken toward more efficient operation of the property, the new car shops which have been built at Decatur, Ill., are important. These are run by electric power and have a capacity of building 25 new freight cars and one new passenger car a day. They are, however, now being used for repairs. These shops were described in the *Railroad Gazette* of January 25, 1907. There has also been established at Decatur a new fireproof supply depot, material and scrap yard to concentrate the material and supplies of the lines east of the Mississippi river which heretofore have been at various scattered points in frame buildings. At Moberly, Mo., the principal division and shop point west of the Mississippi river, a new reservoir with a capacity of 65,000,000 gallons has been finished. More than 200,000 gallons of water are used daily at Moberly and for nine months of the past year before completion of the reservoir, it was necessary to haul water by train to that point. Terminal improvements were made at Chicago, St. Louis, Detroit, Decatur, Kansas City, Council Bluffs and Moberly. Second track for 25 miles was built on the Decatur division between Decatur and St. Louis. A complete change of grade and alignment for five miles with new double track and a large concrete bridge over the Sangamon river will be finished this fall between Decatur and Sangamon, the next station east. This bridge was described in the *Railroad Gazette* of December 21, 1906. There were 80 miles of 80-lb. rail laid in the main line and 200,000 yards of ballast. This completes the ballasting or reballasting of all the main line and important branches. There are now being delivered 60 additional heavy freight locomotives and

Bs. There was also \$3,000,000 appropriated in one way or another for improvements, against \$3,500,000 in 1906. The advance in operating results is shown in the statement that gross earnings per mile increased from \$9,938 to \$10,904 and net earnings per mile from \$2,756 to \$3,151.

The maintenance expenditures are analyzed in detail in the report so that on these points it is unusually clear. Maintenance of way expenses both with and without improvement costs are shown. Straight maintenance of way cost \$927 per mile, against \$983 in 1906. Including additions and improvements, the figures were \$1,093 last year and \$1,235 in the previous year. The 1905 costs were \$1,360 per mile and, including improvements, \$1,592, but this was an exception because of the disorganization of the road by the World's Fair traffic. On the line from Moberly, Mo., east to Hannibal, 70 miles, maintenance of way cost \$2,644 per mile last year, against \$1,377 in 1906. This stretch of line was relaid with heavy rail, completely ballasted and embankments and cuts widened to take care of the heavy traffic which increased from 33,000 tons per mile of road in June, 1905, to 86,000 tons per mile of road two years later.

Repairs of locomotives cost \$2,460, against \$2,037 in 1906; of passenger cars \$612, against \$597 in 1906, and of freight cars \$57, against \$50 in 1906. These figures are based on straight maintenance and do not include any payments for new equipment. The number of locomotives, passenger cars and freight cars is computed from the average number in use on and maintained by the Wabash. These are the ideal conditions for working out these unit figures, but most roads not only do not do it themselves for the information of their stockholders, but give no figures which make possible such accurate averages.

Increased operating efficiency is shown in a number of different

ways. Earnings per freight train-mile increased from \$1.89 to \$2. With an increase of 353,000,000 revenue ton-miles there was a decrease of 4,400,000 empty freight-car miles. Including caboose cars, the empty freight-car mileage was only 24 per cent. of the total, against 27 per cent. in 1906. The revenue trainload increased from 348 tons to 360 tons. Gross earnings per loaded freight-car mile were 10 cents, against 9½ cents in 1906. The average miles run to one ton of coal, however, decreased from 15.8 in 1906 to 14.1 last year, probably owing to the heavier traffic.

The Wabash is steadily progressing under the present management which, though limited in its opportunities, is making a splendid record. This, after all, is the greatest test of ability, to produce good results from insufficient materials.

The following table, rearranged according to our usual method, summarizes the results of operation for the last two years:

	1907.	1906.
Mileage worked	2,517	2,516
Passenger earnings	\$6,891,289	\$6,723,658
Freight earnings	18,465,286	16,138,466
Gross earnings	27,432,474	25,015,379
Maint. way and structures	2,329,510*	2,475,560*
Maint. of equipment	3,379,648†	2,739,283‡
Conducting transportation	12,153,324	10,629,921
Operating expenses	18,551,377	16,503,760
Net earnings	8,881,096	8,511,618
Net income	3,505,046	4,057,613
Dividends on debenture bonds	475,000	
Improvements, etc.	3,043,381	3,548,280
Year's surplus	13,335‡	509,333

*Maintenance of way betterment expenditures, included by the Wabash in operating expenses, amounting to \$418,157 in 1907, and \$633,462 in 1906, are included in "Improvements, etc." below.

†Expenditures for new equipment included by the Wabash in operating expenses amounting to \$535,613 in 1907, and \$940,665 in 1906, are included in "Improvements, etc." below.

‡Deficit.

New York, Ontario & Western.

The New York, Ontario & Western was organized in 1880 as the successor of the New York & Oswego Midland, an unimportant line which ran from Middletown, N. Y., to Oswego, on Lake Ontario. The road was little more than a struggling competitor for odds and ends of trunk line traffic until the middle of 1890, when the Scranton division was acquired, which brought the New York, Ontario & Western into the northern anthracite field. Through purchase of the Scranton Coal Company, in 1899, and the Elk Hill Coal & Iron Company in 1900, a large anthracite tonnage was assured. Since then the road has prospered. Gross earnings per mile, which were \$5,188 in 1890, the year before the Scranton division was acquired, rose in ten years to \$10,331 per mile, and last year were \$15,026. Net earnings were \$1,020 per mile in 1890, \$3,233 in 1900 and \$4,686 last year. Net income per mile during the 17 years, during which the Scranton division has been included in the mileage of the road and its cost in the fixed charges, has increased from \$210 to \$3,031.

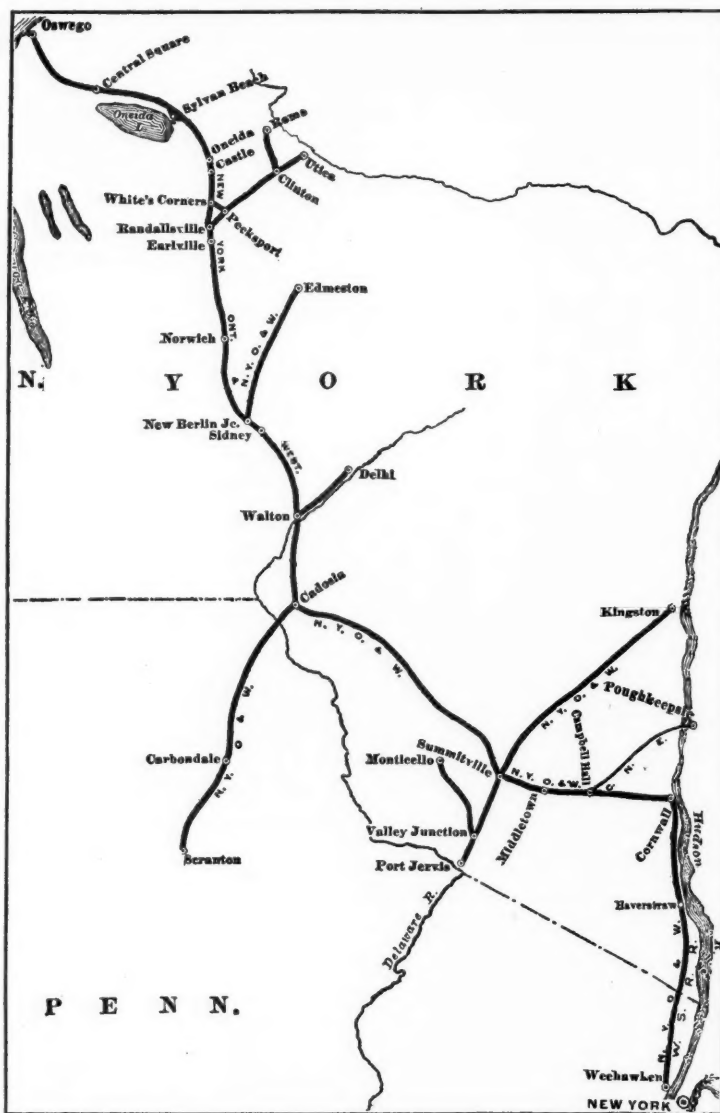
As may be judged from this showing, the Ontario & Western's main dependence is on its coal traffic. Out of total freight earnings of \$6,300,000 last year, earnings from the transportation of coal were \$3,600,000. The total shipments over the Scranton division were 2,700,000 gross tons, of which 200,000 tons were company coal. Of the total output of 55,700,000 tons of the anthracite fields, the Ontario & Western therefore carried 5 per cent. The bulk of this coal was shipped to tidewater, either at Cornwall, 60 miles up the Hudson river, or at Weehawken. There were handled over the company's docks 1,440,000 tons of coal, 761,000 tons at Weehawken, 531,000 tons at Cornwall and 148,000 tons at Oswego. The explanation of the fact that nearly as much was handled at Cornwall as at Weehawken, with its advantages of the New York market and the longer haul, is that the Ontario & Western owns no track south of Cornwall. For the 52 miles between Cornwall and Weehawken it uses the West Shore tracks, paying as rental a proportionate share, based on train mileage, of the cost of maintenance, and a like proportion of interest at 4 per cent. on \$2,000,000, plus the amount spent since the contract went in force on January 1, 1886, for necessary improvements to the line. It is therefore profitable for the Ontario & Western to limit its freight traffic over this stretch of track. Instead of carrying its whole anthracite tonnage to the New York market it distributes a great deal of it at Cornwall by barges and canal-boats, besides what it ships northbound over the West Shore.

The New York, New Haven & Hartford, in October, 1904, bought control of the majority of the common stock as a protection of its sources of coal supply and also as a potential club with which to resist possible severe demands of the trunk lines for new divisions of earnings on through business to New England. The New York, Ontario & Western connects with the Central New England at Campbell Hall, N. Y., from which there is access over the Poughkeepsie bridge to the New Haven system in New England. The extensive improvement of the Poughkeepsie bridge, to put it in shape for heavy traffic, is still under way, as well as improvements to the New Haven's lines east of the river, so that there has never yet been a full test of the new line. However, even with the inadequate facilities, there has been a largely increased movement of coal traffic

over this route since the New Haven bought control. Besides this there was established a year or more ago the Ontario Central Despatch, a fast freight line between the West and New England, operating over the New York, Ontario & Western and the Poughkeepsie bridge, and this has increased merchandise shipments through this gateway.

When the New Haven bought control of the Ontario & Western the common stock was not paying dividends. The \$2,000,000 preferred stock—all but \$4,000—having been exchanged for mortgage bonds, was deposited in a voting trust which elected a majority of the directors. In order to get actual control it was necessary to pay a dividend on the common stock. A dividend of 3 per cent. was paid on January 16, 1905. The voting trust was therefore terminated and the New Haven elected a majority of the directors. In July, 1905, 1½ per cent. was paid and in each of the two succeeding years 2 per cent. has been paid on the common stock.

Next to coal and local freight, through freight and milk furnish the most important sources of freight revenue. Each of these classes of traffic brought in between \$700,000 and \$800,000 last year, while



New York, Ontario & Western.

local freight earnings were \$1,177,196. Passenger earnings were \$1,550,000, against \$1,380,000 in 1906, of which \$1,288,000 came from local passengers and \$267,000 from through and immigrant business. There is a large business from New York to summer resorts in Orange, Sullivan, Ulster and Delaware counties, which last year was so large that few passenger coaches could be spared for excursions. There were, however, 52 excursions run, carrying 17,881 passengers, with a revenue of \$20,067, or \$5.29 per train mile.

Gross earnings were \$8,200,000, against \$7,300,000 in 1906. Operating expenses increased \$400,000, leaving net earnings of \$2,750,000, against \$2,200,000 in the previous year. The surplus of the year was \$490,000, against \$25,000 in 1906.

Conducting transportation increased only 5 per cent., while more was spent on both classes of maintenance. Maintenance of way cost, \$2,035 per mile, against \$1,810 in 1906. Repairs and renewals cost \$2,636 per locomotive, against \$2,568 in 1906; \$789 per passenger car, against \$594 in 1906, and \$68 per freight car, against \$58 in 1906.

President Fowler records that the physical condition of the

property is much better than at any time in the previous history of the company. Except for about six miles in the vicinity of Liberty, N. Y., which is under construction, and certain tunnels, second track from Cadosia to Cornwall, 108 miles, is in operation. New equipment was bought during the year to meet the increasing requirements of the summer passenger traffic. Eight or ten new coaches should be bought during the present year for this same purpose. The rest of the rolling equipment is said to be in excellent condition and sufficient. In order to increase the boat equipment used for carrying coal from terminal points, 10 small boats for river and harbor deliveries and 3 barges for use to more distant parts were bought. Two tugs are also under contract for the same service. With this increased floating equipment it is expected to make coal deliveries more satisfactory and economical.

The operations of the last two years are shown below:

	1907.	1906.
Mileage worked	546	546
Passenger earnings	\$1,553,997	\$1,376,043
Freight earnings	6,326,642	5,589,444
Gross earnings	8,202,361	7,265,058
Maint. way and structures	1,002,729	892,100
Maint. of equipment	1,250,562	1,104,835
Conducting transportation	3,027,418	2,895,393
Operating expenses	5,449,968	5,059,090
Net earnings	2,752,393	2,205,968
Net income	1,654,782	1,187,501
Dividends	1,162,302	1,162,296
Year's surplus	492,480	25,205

Chicago, Indianapolis & Louisville.

This railroad has a line from Indianapolis to Chicago and another north from Louisville, Ky., to Michigan City, Ind. The two cross at Monon, Ind., whence the familiar name of the road, the "Monon Route." Except for two short branches to reach the coal fields south of Terre Haute and a branch to the pleasure and health resort of French Lick Springs, the road has through lines and nothing else. The branch from Quincy southwest to Shirley Hill was finished in September, having been built under the name of the Indianapolis & Louisville Railway. Locally, stone, sand and other like articles furnish the largest proportion, 28 per cent., of the tonnage. For miles the road runs through the Bedford stone region. Bituminous coal comes next with 11 per cent. of the total tonnage. On through business the greatest strength of the road lies in the fact that it is controlled jointly by the Louisville & Nashville and the Southern Railway and furnishes both of them, from Louisville, a northern outlet to Chicago. For this reason it gets an added share of traffic destined to and from both of these great southern systems.

The past year's record is not a particularly encouraging one from the standpoint of earnings. Gross earnings increased only \$68,000,000, or 1 per cent., a small increase for so generally prosperous a year. Operating expenses increased \$182,000, or 5 per cent., leaving a decrease of \$114,000 in net earnings. An increase of \$44,000 in taxes made a total decrease in net earnings after operating expenses and taxes, of \$158,000. In this connection President McDoel states that the valuation of the main line has been increased by Indiana 39 per cent. in two years. Net income was \$995,000, against \$1,198,000 in 1906. As the dividend disbursement was the same in each year, the year's surplus was \$480,000 last year, against \$683,000 in 1906.

There were small increases in each of the operating expense accounts, the largest being in conducting transportation, which rose from \$1,987,000 to \$2,082,000. This, however, was an increase of only 5 per cent., which is not a bad showing in a year of largely increased costs. There was spent for maintenance of way \$1,369

per mile of road, against \$1,328 in 1906. Repairs and renewals of equipment cost \$2,958 per locomotive, against \$2,632 in 1906; \$1,044 per passenger car, against \$1,087 in 1906, and \$62 per freight car in both years. These are liberal figures, particularly for locomotives and for passenger cars. The company owned, on June 30, 1907, 300 less freight cars than a year earlier.

The rate received per ton of freight per mile has shown a steady increase during the last three years. It was 0.790 cents in 1905, 0.796 cents in 1906 and 0.810 cents last year. The passenger-mile rate, on the other hand, decreased from 2.074 cents to 2.027 cents during the year owing to the 2-cent-a-mile law in Indiana, which was in force for several months. Next year it is likely to show a further decrease. There were less tons of freight carried and more passengers. The trainload fell off from 312 tons to 307 tons.

The total tonnage is divided by general groups as follows: Agricultural products, 14 per cent.; animal products, 4 per cent.; mine products, 41 per cent.; forest products, 11 per cent., and manufactures, merchandise, miscellaneous, salt, ice and fertilizer, 30 per cent. Of this last group, manufacturers make up 14 per cent., miscellaneous 8 per cent., and merchandise 5 per cent. The interchange traffic with the southern roads is here reflected. It was this group of traffic, too, which specially increased last year, while there was a falling off in bituminous coal, stone and sand tonnage.

Of the 518 miles of line owned, 428 miles are laid with 75-lb. rails, the rest with 67- and 60-lb. steel. During the last year 63 miles of new 75-lb. rail were laid. There were other improvements such as extensions of sidings, new bridges, a new 9-stall engine house and co-ordinate facilities at New Albany, which is across the river from Louisville, new interlocking at crossings with other railroads and new track scales.

President McDoel speaks as follows in regard to the railroad legislation of the past year:

"All laws passed by the last session of the legislature of Indiana with reference to railroads and their operation, notably, the Railroad Commission Act, the Shippers' Bills, the Railroad Passenger Rates, Two Cents per Mile, Railroad Baggage Act, Employees' Act, etc., have the effect of decreasing our earnings and increasing our expenses, to what extent we are not yet able to determine."

The following is a summary of the income account for the past two years:

	1907.	1906.
Mileage worked	600	591
Passenger earnings	\$1,432,978	\$1,402,347
Freight earnings	4,199,673	4,166,413
Gross earnings	5,988,867	5,921,002
Maint. way and structures	837,805	785,278
Maint. of equipment	839,466	812,258
Conducting transportation	2,081,946	1,987,334
Operating expenses	3,899,595	3,717,924
Net earnings	2,089,273	2,203,078
Net income	995,027	1,197,637
Dividends	515,000	515,000
Year's surplus	480,027	682,637

NEW PUBLICATIONS.

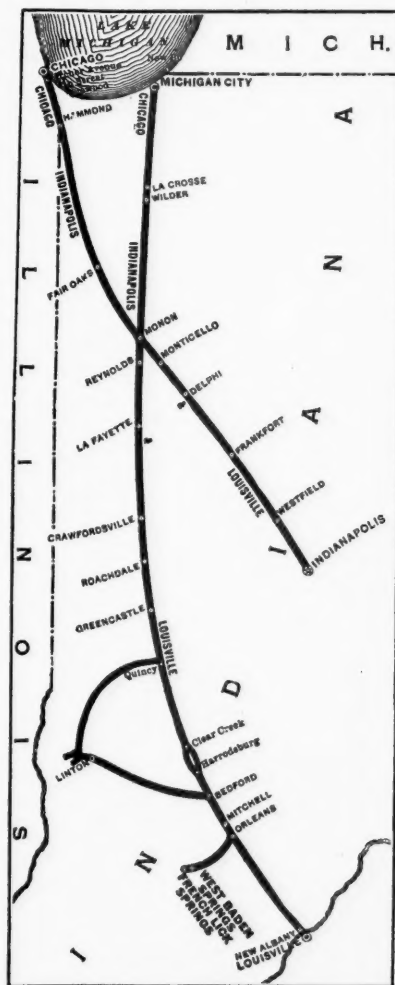
Strength of Structural Timber. Circular No. 115 of the Forest Service. Published for free distribution by the Department of Agriculture, Washington, D. C.

Before putting a timber into a structure every builder must know the strength of the timber and the maximum load it will have to carry. Building laws generally require that the material used shall be from three to six times as strong as is actually necessary.

Loblolly, longleaf and Norway pines and tamarack are among the principal structural timbers of the eastern United States, and Douglas fir and western hemlock of the western states. In the trade, loblolly pine is classed both as Virginia pine and as North Carolina pine. Virginia pine is made up principally of timber from the northern part of the loblolly pine belt, and is inferior in quality to the North Carolina pine, so that the distinction is one of grade rather than one of locality. Longleaf yellow pine, as known on the market, may include the better grades of shortleaf pine and Cuban pine. It has for a long time been the standard construction timber of the East. Norway pine, also known as red pine, is cut principally in Michigan, Wisconsin and Minnesota, where it is marketed with white pine as northern pine. Douglas fir, called in different localities yellow fir, red fir, Oregon pine and Douglas spruce, is cut most extensively in Washington and Oregon. Western hemlock, which is obtained from the same region, is far superior to the eastern hemlock for structural purposes. On account of the prejudice against it, it is often sold under such names as Alaska pine and Washington pine, spruce or fir.

Recent tests made by the Forest Service on full-size structural timbers of commercial grades show longleaf pine to be the strongest and stiffest of all the timbers named, with Douglas fir a close second; while western hemlock, loblolly pine, tamarack and Norway pine follow in the order given. Fortunately, Douglas fir and western hemlock, of which there are comparatively large supplies, have high structural merit, as has also loblolly pine, the chief tree on which the southern lumber companies are depending for future crops.

Much of the information hitherto available concerning the



Chicago, Indianapolis & Louisville.

strength of timber has been secured from tests of small pieces without defects. This cannot safely be assumed to hold good for large-sized timbers as found on the market, since these commonly contain such defects as checks, knots, cross grain, etc. The location of the defects varies the extent to which they lessen its strength; and the proportion of heart and sap wood, and the state of seasoning, must also be considered.

Freight Car Bulletin No. 8.

The Committee on Car Efficiency of the American Railway Association, Arthur Hale, Chairman, has issued its statement of freight car balance and performance for May, 1907. The introduction summarizes the results as follows:

With a lessening demand for cars during the period covered by this report, the tendency was toward home movement. The increase in the "Average Miles per Car per Day," in the face of a marked reduction in the shortages which had existed for some months on a majority of the roads, can also be partially accounted for by the homeward movement of foreign cars, as indicated by the decrease in the "Per Cent. of Loaded Mileage." That there was a net improvement in performance, however, is denoted by the increase in the "Average Ton Miles per Car per Day" and the "Average Earnings per Car on Line." With an increased empty haul and a stationary "Average Loading per Car" the credit for this improvement must be given to the "Miles per Day."

While the percentage of cars in shop shows an increase over April, this is by no means a discouraging sign. In fact, a noticeable decrease in this figure at this time would be an indication of the retrenchment which too frequently follows a falling off of business, especially toward the close of the fiscal year.

This policy, when persisted in, results in neglect of car and engine repairs during periods of comparative plenty, and has a serious effect on efficiency when business picks up and cars are in demand. Cars which have been allowed to deteriorate while not needed soon give way under the strain of heavy traffic, and the result is a high percentage of cars in shop when they can least be spared from revenue service.

Similarly, a failure to keep the motive power in first-class condition further impairs the efficiency of cars. In many cases the cause of a local shortage may be traced directly to poor car performance, which in turn is frequently due to inadequate motive power.

The committee, in its work of transferring equipment from roads which are over to others which are short, has encountered instances where a lack of motive power has prevented the short roads from promptly handling empty cars offered them by roads which held a surplus. The results in these cases were loss of earnings on the one hand and increased per diem charges on the other.

If all railroads would avail themselves of the opportunity which a slack season affords to put their equipment and power in the best of condition, the result would be apparent on the resumption of heavy business, in a higher efficiency and increased earnings.

There is one feature of the shop situation which has a marked effect on car efficiency but which does not appear in the performance statements except as it affects the results. We refer to the practice of routing cars home on account of bad order.

The committee has frequently observed that even during times of extreme shortage, large numbers of cars with defects which prevent their use under load but do not render them unsafe for empty movement, are carded home, involving long hauls, in many instances over roads which are short of cars for loading in the same direction or which could furnish them to their connections for loading if the necessary repairs were made.

This condition is largely under the control of the individual roads whose earnings and expenses are affected. Possibly as the common use of cars is extended there will be less distinction made in the matter of repairs as between foreign and home cars.

Grain Shipments in Russia.

At a conference of railroad managers in Russia recently to consider the best means of forwarding the last crop of grain and to avoid the blockades and accumulations at stations which have been great in many previous years, it was decided to require the shippers to deliver the grain sacked, so that open cars might be used. It is something like 30 years since the American system of shipping grain in bulk was introduced into Russia, with important saving to the shippers; and it is not probable that the shippers can possibly obtain sacks in time for this year's crop.

Audible Distant Signals on the Great Western.

The audible distant signals installed on the Witney & Fairford line of the Great Western Railway of England, acting in the cab of the locomotive, have now been in use more than six months since the provisional approval issued by the Board of Trade, and their behavior is reported as highly satisfactory. In this apparatus connection is made from the signal tower or cabin to the apparatus on the locomotive without the use of any movable parts on the road-

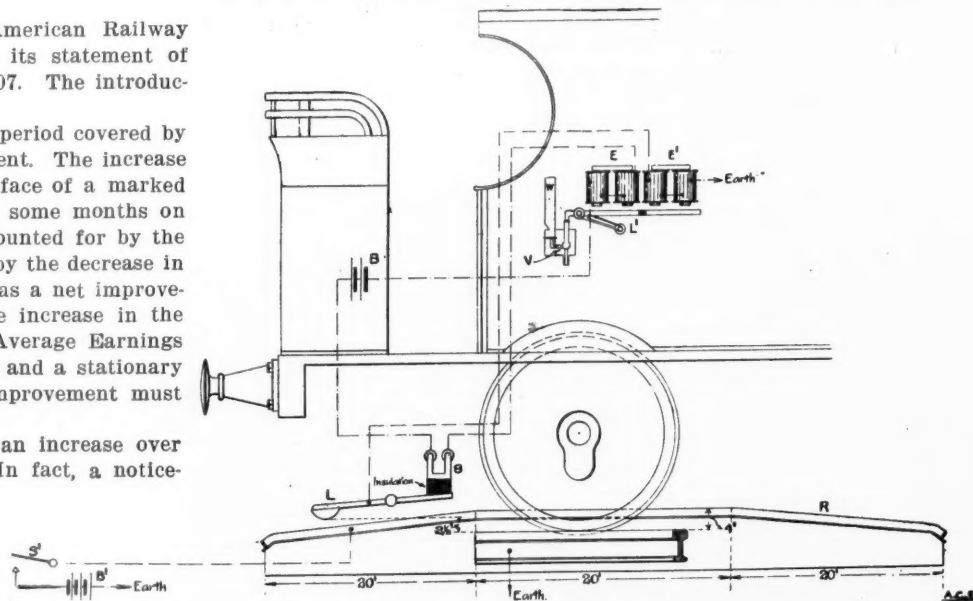


Fig. 1—Audible Cab Signal; Great Western Railway.

way. A bell is rung in the cab to indicate all-clear, and a whistle is blown to indicate caution. The arrangement is depended upon for actual service, the visual signals formerly in use having been taken down. The approval of the Board of Trade was given with this understanding; that is to say, the audible signals are used as a substitute for the visual distant signals and not merely as an adjunct. The clear signal is given by the closing of an electric circuit in the signal cabin, and the circuit closer, by which this is effected, is interlocked with the home signal levers the same as in

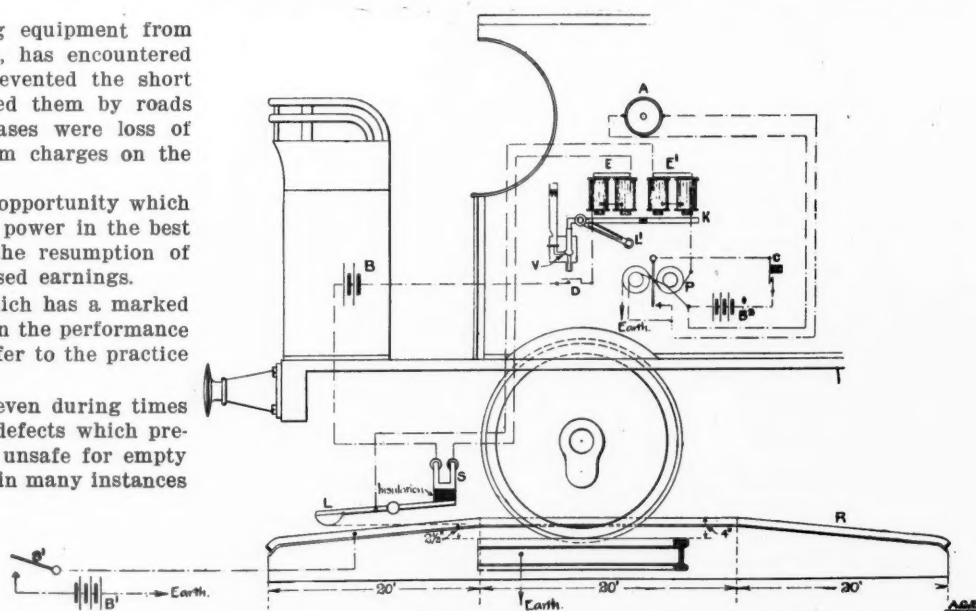


Fig. 2—Audible Cab Signal with Polarized Relay.

the case of an ordinary distant signal. The line on which this device is used is in Gloucestershire, and is 22 miles long.

The arrangement of the principal parts of the apparatus is shown in the accompanying drawing, Figs. 1 and 2. There is a single contacting device on the engine. The "caution" signal is given by the destruction of a local electric circuit on the engine, through the lifting of a lever or plunger, which invariably occurs at each signaling position. The "clear" signal is actuated by an electric current, picked up from the ground apparatus by the lever or plunger. The current in addition to causing the bell to ring prevents the giving of the "caution" signal. Since the operation of the "caution" signal depends upon the lifting of the shoe, while the suppression of this signal depends upon the successful picking up of an electric current, it will be seen that neither snow

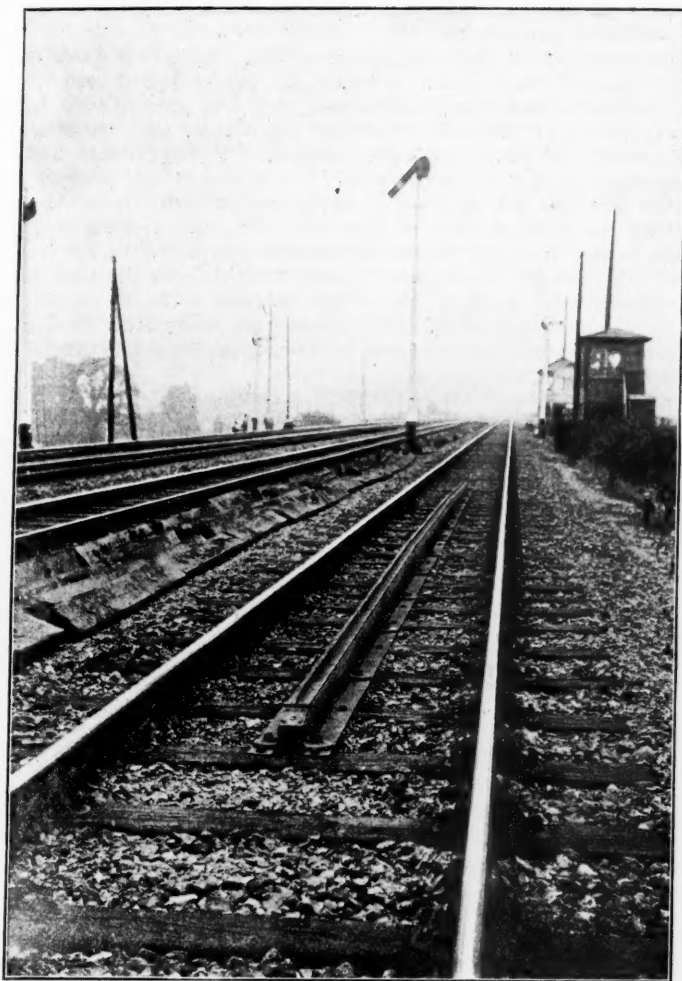


Fig. 3—Ramp Between Rails.

nor electrical failure can have the effect of preventing the giving of a caution signal.

At each signaling position there is fixed in the center of the track a ramp R, Fig. 1, consisting of a bar of T-iron, suitably mounted and insulated on a timber base, the highest point of which is 4 in. above rail level. The iron bar is electrically connected by

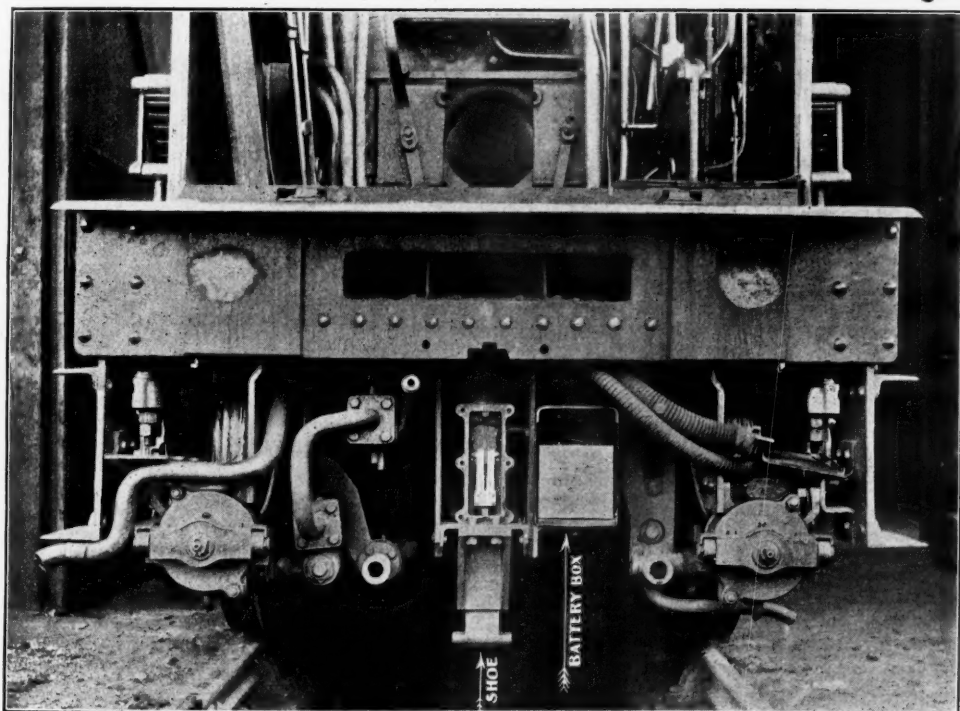


Fig. 4—Contact Shoe on Locomotive.

means of a telegraph wire to a switch S' in the signal cabin. By means of the switch, a battery B' is put in connection with the ramp when it is desired to give the "clear" signal on the engine. Normally, the switch S' is not closed. The contacting shoe L on the engine is insulated from the mass of the

engine, and the switch S, which is mechanically connected to the shoe, is insulated both from it and the mass of the engine. The normal position of the shoe is such that its lowest point is $2\frac{1}{2}$ in. above rail level. When it comes in contact with the ramp it is raised $1\frac{1}{2}$ in.

The electro-magnets E and E' on the engine have armatures yoked together and the compound armature K (Fig. 2) thus formed, when held up by either magnet keeps closed the valve V of the whistle W. The whistle valve is constructed on the principle of a safety valve, and is normally prevented from opening by the armature being held by the electro-magnet E. This electro-magnet forms part of a local circuit on the engine, which includes the battery B and the switch S. When shoe L is in its normal position, switch S is closed; the local circuit then being complete, the electro-magnet holds the compound armature and keeps the whistle valve closed. The lifting of the shoe L less than $\frac{1}{2}$ in. above its normal position will open the switch S, and electro-magnet E being no longer energized, the compound armature will drop. Thus, when the shoe passes over the ramp (the ramp not being electrified), and is raised $1\frac{1}{2}$ in., the local engine circuit is opened and the whistle sounded, indicating caution. On the shoe clearing the ramp and the local circuit being again completed, the electro-magnet is once more capable of holding the compound armature, but in order that it may do so, the engineman must lift the armature near to the poles of the electro-magnet, for which purpose a small lever L', is provided.

So much for the "caution" signal. To suppress this and give an all-right signal, the signalman, having cleared his home and starting signals, closes the circuit of battery B' at switch S'. Electro-magnet E' is electrically connected on one side to the shoe L and on the other side to earth through the mass of the engine and the running rails. The shoe, in passing over the ramp will then, in addition to opening the switch S, also complete the circuit from battery B' to the electro-magnet E'. Consequently the latter will be energized and be capable during the passage of the shoe over the ramp, of holding the armature and keeping the whistle valve closed.

The suppression of the "caution" signal is not in itself a positive "clear" signal, this consisting, as already mentioned, of the ringing of a bell. Fig. 2 is an amplification of Fig. 1, showing on the engine in the circuit of the electro-magnet E' one winding of a polarized relay P. When current is picked up from the ramp, it will, in addition to energizing the electro-magnet E', also energize the polarized relay, the armature of which will close a local circuit and ring bell A. The second winding of this relay is for the purpose of keeping the local bell circuit closed, so that the bell may continue to ring after the shoe has passed over the ramp and until the bell circuit is momentarily opened by the engineman pressing on circuit-breaker C.

Switch D is controlled by a steam-operated valve, so arranged as to open the circuit when the boiler pressure falls to about 20 lbs. This automatically opens the circuit of battery B, and prevents waste of current when the engine is not in running condition.

Battery B' consists of about 16 No. 2 Leclanché cells; battery B of two large dry cells, and battery B' of four small dry cells.

For fast-running lines a ramp 60 ft. long has been found suitable; for moderate speeds 40 ft. The ramp must be long enough to ensure the switch S being open a sufficient time to de-energize electro-magnet E.

In connection with the Witney & Fairford line installation, two short ramps are provided in the locomotive yards at Oxford and Fairford, so that the signals may be tested before an engine passes out for use. The highest point of the "caution" testing ramp is only 3 in. above rail level, therefore the "caution" signal sounds when the shoe is lifted $\frac{1}{2}$ in., or one-third of its working lift. The shoe is 7 in. wide and its face is case-hardened. A strong spiral spring is provided to ensure prompt return of the shoe to the normal position on leaving the ramp.

Single-Track Working.—An engine in passing from one station to another, say from A to B, will pass over two ramps, one applying to trains coming from B, the other to trains going to B, and it is desirable that it should only receive a signal at the latter. Re-

ferring to Fig. 2, it will be seen that the ramp is electrified by the signalman connecting the negative end of the battery B' to the ramp. If, instead the positive end of the battery were to be connected to the ramp, the "caution" signal would still be suppressed, but the bell would not ring, since the armature of the polarized relay would

tend to move away from instead of toward its contact post. Thus when an engine passes over a ramp applying to the opposite direction to that in which it is running, provision is readily made for suppressing both the caution and the clear signal. In order that it shall not be possible for the signalman to wrongly electrify a ramp when a train is approaching his station, the levers in the locking frame controlling the hand switches used for electrifying the ramp are interlocked with the electric train staff or tablet circuit, so that the wrong lever cannot be thrown.

The apparatus is covered by patent No. 12,661/05, granted to Messrs. Jacobs, Insell, Newton and Bowden, and patent No. 25,955/05, granted to Messrs. Insell and Jacobs, all of the company's staff. The installation has been made under the direction of Mr. A. T. Blackall, the company's Signal Engineer.

Interurban Fares.*

BY THEODORE STEBBINS.

The subject of interurban fares is one of immediate interest because matters connected with the transportation of persons and property by railroads have been the subject of very active and even violent popular discussion. The state legislatures have been taking blind actions and state executives have been advocating and adopting arbitrary measures with the railroads. Twenty state legislatures have passed restrictive legislation on passenger rates, and fourteen states now limit passenger rates to two cents a mile. In this situation, it is important to understand the position of the interurban railway.

All interurbans are anxious to serve the public and to earn reasonable dividends for stockholders. It is not so clear, however, how rates shall be adjusted to satisfy these ends. It is customary to measure the service and its cost on the basis of cents per passenger-mile. The charges range from three cents per mile in unsettled sections down to half a cent per mile for commuters in thickly settled districts, who use the cars twice each working day, or where excursions are handled in bulk. The ordinary range of fare, however, is between two cents and one cent per mile. We find the two cents per mile charge prevailing in the Middle West, and the one-cent rate common in thickly settled districts, mostly in the East. Tables have been published showing the charges made by various roads. For example, the convention issue of the *Street Railway Journal* for October, 1906, on page 672, gives the rates for various classes of tickets charged in Ohio and adjoining states, and shows that the average single trip fare in this locality is upward of two cents per mile. It will also be observed, however, that other and lower rates are made on such roads for regular daily passengers down to about one cent per mile. These western roads sell forms of tickets and make rates corresponding in a variety of forms and variation of rates with the steam roads.

At the other extreme we find certain interurban roads charging one cent per mile, and the majority of such roads make this a uniform charge to all adults, and their character of travel approaches that of the ordinary street railway company.

Tables can be prepared, giving the rate charged by the various companies, but these are meaningless without knowing at the same time the conditions under which such roads are operating, and so we will seek to indicate the justification for these variations in fares.

The cost per car-mile of operation does not afford a direct measure of the rates that should be charged to passengers. The density of travel has a far greater influence on rates. The road must be built and furnish a service to suit the distribution and density of population, and the fares that can be collected follow as a consequence of this environment. The cost per car-mile may not vary much between properties quite different in character, but it is the commercial and social habits of the people which determine the quantity and times of traveling as well as the percentage of the carload (that is, passenger-miles divided by seat-miles) and thus the passenger rates are determined.

COST OF SERVICE.

The seat-mile cost can be figured as shown for illustration in the following table, which indicates also the effect on such cost of more frequent service:

	A	B	C
Annual cost per mile of track.....	60	30	15
Headway (minutes)	15,000	30,000	60,000
Car-miles (plus extras).....	\$1,800	\$3,600	\$7,200
Cost of operation.....	2,700	3,600	4,500
Interest and depreciation.....	\$4,500	\$7,200	\$11,700
Cost per car-mile (cents).....	30	24	20
Car seating capacity.....	40	40	40
Car seat-mile cost (cents).....	75	6	5

The actual passenger rate per mile must be more than the car-seat cost as a minimum in proportion, as the passenger-miles are less than the car-seat miles. If the passenger load averages 40 per cent. of the seating capacity then, on a 60-minute headway, the average cost would be $\frac{100}{40}$ times 0.75 cents, or $1\frac{3}{4}$ cents per mile. This indicates how much rates might be decreased if full loads were

*A paper read before the American Street & Interurban Railway Association at its Atlantic City Convention, 1907.

constantly carried, and why some roads can afford to make mileage rates less than other roads.

The distribution and occupations of the population along the line are the powerful elements affecting the percentage of load. Assume two roads, each fifteen miles long; the first joining two cities of large size with little intermediate population, and the second leaving a city and traversing a succession of villages growing smaller and terminating in a country hamlet. The first road may prosper on one cent per mile and the second starve on two cents, even though operating the same number of cars with the same number of passengers to and from the principal terminal. In the first, the loads are carried through; in the second case, two-thirds of the load may be dropped within the first four miles. Assume a third case where a succession of towns of equal importance are traversed. The cars may load and unload several times in the course of the trip, and this makes for an intermediate policy on rates.

DENSITY OF TRAVEL.

To give some idea of the variation in density of travel on electric railways, the following figures are given:

Territory.	Passenger per mile.	Average fare	Receipts per mile.
United Kingdom	939,658	2.26 cents	\$21,240
United States.....	333,862	3.76 cents	12,553
Indiana	133,000	5.6 cents	7,500

The above figures for the United States and Indiana include all electric railways; that is, both city and interurban. The density of travel on the Ohio interurbans is indicated in the following table, grouping them together according to principal terminal:

Extending centrally through the building from main waiting

Principal Terminal.	Its population.	Receipts per mile.
Cleveland	500,000	\$5,045
Columbus	200,000	3,829
Toledo	225,000	3,257
Dayton	90,000	3,137
Miscellaneous .....	.....	3,542

Twenty-eight interurbans in this same section are classified in annual receipts as follows:

0.....	\$2,000	4	8	19
2,000.....	2,500	4	11	
2,500.....	3,000	7		
3,000.....	3,500	4		
3,500.....	4,000	1	4	9
4,000.....	4,500	3		
4,500.....	5,000	1		
5,000.....	up	4	5	

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Most of these roads furnish hourly service, so that by making some additions for limited and excursion cars, the receipts per car-mile can be calculated, and assuming the average rate to be 1.5 cents per mile, the number of passenger-miles and its relation to the car-seat mile capacity can be determined.

As indicating the variation in car-miles per mile of road, it may be stated that the elevated roads in New York operate 1,635,000 miles per mile of road, as against 15,000 or less for the ordinary interurban road in the Middle West, while the expenses per car-mile on the elevated are nine cents per mile, as compared with about 14 cents for the Middle West interurban.

The expenses per car-mile and per seat-mile for a known service are capable of calculation with mathematical precision, but the density of the traffic can only be learned by experience, and this experience indicates how much the rates charged must be increased beyond the basic seat-mile cost.

WESTERN INTERURBANS.

For the average conditions prevailing throughout the Middle amount of testimony is available to show that the basic single trip rate should be upwards of two cents per mile. If less is charged, not enough additional travel is secured to increase the gross receipts. If more is charged, travel is curtailed and the gross is reduced. In stating this it must be understood that mileage, commuter and other lower rates are granted and maintained at proper relation to the single trip rate.

The widest consensus of opinion on the subject is found in a resolution passed by the Ohio Interurban Railway Association on May 25, 1905. This association represented about 2,000 miles of interurban roads and the matter was given earnest consideration in private discussion between the members and in the open meeting. The resolution reads as follows:

"WHEREAS, A demand for improved service on interurban roads has very largely increased the operating expenses of such roads, and many roads have met this demand; and,

"WHEREAS, In order to obtain their share of the business many other roads contemplate improving their service in like manner; and,

"WHEREAS, The prevailing low rate of fare on most interurban roads will not permit of such improvement in service, therefore, be it

"RESOLVED, That the Ohio Interurban Railway Association recommend a uniform base rate of two cents per mile, and a minimum charge of 10 cents."

Mr. A. H. Royce, secretary and treasurer of the Canadian Street Railway Association, writes:

"Since the reduction to two cents a mile (by legislative act) the

companies have done away with all commutation tickets and charge a flat rate of two cents a mile. We find that it is impossible to operate a road properly and keep up the rolling stock and equipment even at less rate.

"In the other provinces of Canada, the rates of fare are regulated by agreements with the municipalities through which they operate. There is no legislation affecting these rates, and as a rule the charge is three cents a mile."

Mr. J. McM. Smith, General Manager of the Southern Michigan Railway Co., writes:

"We started out a year or two ago on the rate basis of $1\frac{1}{2}$ and $1\frac{3}{4}$ cents per mile, but we found this to be entirely too low, and accordingly we made a uniform raise. It is my belief, based on long years of experience in this business, that a road must be exceptionally well located if it can be made profitable on a rate less than two cents per mile."

Mr. S. Hendrie, General Manager of the Grand Rapids, Holland & Chicago Railway, writes:

"I am inclined to think that all our interurban passenger fares in Michigan are too low in view of the increase in the wages and in the cost of all materials which enter into the construction and operation of electric roads to-day. In 1894-96 I took franchises for a road on the average of one cent per passenger mile, but new steel then cost \$16 per ton, copper 13 cents per pound, number one standard ties 35 cents each, common labor \$1.50 per day, etc. At that time, conductors and motormen were paid 17.5 cents per hour, and other labor in proportion. The same road could not be built to-day for twice its cost, and although the fixed charges are low, the present owners are not satisfied with its net earnings."

Mr. H. H. Polk, President of the Inter-Urban Railway Company of Des Moines, Iowa, writes:

"The rates generally charged are as follows: Two cents a mile for single trip tickets; 1.5 cents for round trip tickets, good for one day; 1.25 cents for mileage. (These mileage books are for any three people, and good until used.) However, I am of the opinion that our round trip and mileage rates are too low, and we are seriously considering the raising of these rates. With the universal two cent fare now forced on the steam railroads by state legislatures, I am of the opinion that it will be rather up-hill work for interurbans to exist at the present rates."

Mr. C. N. Wilcoxon, general manager of the Cleveland & Southwestern Traction Company, writes:

"There are very few roads in this state operating at less than two cents per mile, with the usual reduction for commuters' tickets, etc. The average rate obtained by the Ohio roads is approximately 1.65 cents per mile. To attempt to operate on a 1.25 cents per mile basis would mean bankruptcy to the interurban roads of this state."

Mr. H. A. Nicholl, of the Indiana Union Traction Co., writes:

"Our single trip tickets are 1.5 cents per mile. This is as low a rate as I believe any electric road can carry passengers with a reasonable profit."

EASTERN INTERURBANS.

From the average conditions prevailing in Massachusetts, New Jersey, some parts of Pennsylvania and other sections with considerable density of population, a large amount of testimony is available to show that the heavier travel, the more frequent trips, the shorter rides, and repeated loading and unloading in a trip, make profitable and advisable no variety of tickets, but only a single adult rate.

Mr. M. C. Brush, Vice-President of the Newton Street Railway Co., and associated companies, writes:

"I find upon careful investigation that on about 50 per cent. of our lines our fares vary from 1 cent per mile to 1.5 cents per mile. On the remaining 50 per cent. it varies from 0.4 to 0.9 of a cent per mile. The average New England street railway manager does not believe that under present operating conditions it is possible to carry a patron more than five or six miles for 5 cents. That is, I think you will find that the average New England manager believes that 1 cent per mile is a fair charge in this territory."

NOTE.—The Massachusetts law requires half rate for school tickets.

Mr. F. L. Fuller, Vice-President and General Manager of the New York & Queens County Railway Co., writes:

"The rates on Long Island are 1 cent per mile, collected in 5-cent zones."

Mr. F. W. Bacon, General Manager of the New Jersey & Hudson River Railway & Ferry Co., writes:

"I do not think the rates in New Jersey on interurban roads are in excess of 1.25 cents per mile, and our average rate is 1.15 cents per mile, but we do not issue commutation tickets or other forms at any cheaper rates, and only make 25 per cent. reduction on school tickets."

CALIFORNIAN INTERURBANS.

The extremes on rates seem to exist in California. Mr. Schindler, of Chico, Cal., makes most interesting statements. His line, in the Sacramento valley, has steam railroad conditions, and charges

3 cents per mile, and his patrons are well satisfied. In the southern part of the state business is done mostly on round trip tickets at 0.6 of a cent per mile. He states:

"It is a curious fact that in the southern territory where existing rates are already extremely low, there is a strong movement toward a further reduction of rates; while here, where the highest rates exist, the public is generally well satisfied."

The above quotations are taken from letters on the subject of "Rates," addressed to our secretary, Professor Swenson, to whom I am much indebted for this and some statistical information.

Examination shows a clear distinction in conditions and practice between the 2 and 1 cent rates per mile.

The 1 cent rate applies to conditions approaching those of the city railway, 5 cent zones, no tickets, a succession of towns, with contiguous population limits.

The 2 cent rate applies to cities and towns considerably separated, where passengers may travel 25, 50, 100 or 200 miles, and this rate applies to occasional travelers on single trip or interline tickets. Tickets are also sold and gradations of adult rates for commuter and school travel are made down to 1 cent per mile. For interurbans of this character, we will describe the kind of tickets sold.

KIND OF TICKETS.

1. The single trip ticket (good between specified points for an adult) is the basis of maximum charge on each interurban line. Occasionally, a higher rate is charged for fare paid on the cars, but this practice is diminishing, because it entails a greater variety of fares and discriminates against the farm community boarding the cars where ticket offices cannot be maintained, and this farm community is often the most important class of customers for the road. To increase the sale of tickets in order that cash may be taken at the offices and not by the conductors, it has been proposed to charge higher cash fares on the cars and give receipts with a redeemable value to any ticket office the same as some steam railroads do, but this is impracticable for interurban conditions and in one case only to my knowledge has been adopted.

2. The round trip ticket, good for an adult, is the most common form of ticket, in fact is sold by some roads where single trip tickets are not sold, and is ordinarily sold at a 10 per cent. reduction over double the single trip rate. In a few cases the reduction is 20 per cent.

3. Interline tickets are those sold by one road for transportation over its own line and one or more connecting lines, usually not more than three. Such a ticket, when sold for a round trip may be nearly a yard long and practically correspond in form and appearance to the familiar steam railroad ticket. The interurbans of the Central West sell large numbers of these tickets and they are essential in competition with the steam railroads.

4. Mileage books, so-called, are sold at 16 $\frac{2}{3}$ per cent. to 33 $\frac{1}{3}$ per cent. reduction from the base rate. If such books are good for a specified number of miles, 500 or 1,000, then the conductor must carry a sheet of mileage distances between points and detach coupons accordingly. The reservation is commonly made that no less than five coupons shall be detached. Since the rates per mile charged on different roads and often on various sections of the same road vary for franchise or other reasons, it has therefore been found expedient to issue "Mileage Books" not for a specified number of miles but containing a certain number of 5 cent coupons. This avoids the necessity of conductors carrying mileage cards, permits detaching coupons of a face value equal to the single trip ticket; reduces the complexity of accounting and in general is practical where mileage coupons are impracticable. Properly these are called Coupon Ticket Books and if good on one road "Local"; if good on a group of roads, "Interchangeable"; but we continue to speak of them in common parlance as "Mileage Books." Such interchangeable books issued by certain members of the Central States Interurban Association contain 240 5-cent coupons, face value \$12, sold at a net price of \$10. These books are good for use over some 37 railways and their underlying companies all operating several thousand miles of track. This book is good for one person only, usable within one year and not less than two 5-cent coupons are detached for any ride, no matter how short. Each individual company is free to issue, also, mileage books good over its own line under such conditions as it may see fit. In some cases these are good for use without restriction as to name and number of persons and at a slightly lower rate.

5. Commuter books are also sold, good commonly only for either 30 days or a calendar month, and containing 40, 50 or 60 rides, each book limited to one name. Such books are not in as common use now as the writer believes they will be in the future, as they form a means of building up a steady suburban travel, the same as steam roads operate so profitably out of our large cities and without interfering with higher charges for occasional travelers.

6. Book tickets are sold for 10, 20, 30, 40, 50 or 100 rides, with or without limitation as to name or family, or length of use and on some roads serve the same purpose as commuter books.

7. Excursion tickets are sold by almost all roads for special occasions, usually limited to one day and issued for summer riding to

parks, church picnics, political meetings, city shopping and a great variety of purposes.

8. Half rate tickets are sold for single and round trips of children from 5 to 12 years of age.

9. Party tickets are sold for a specified number of persons traveling together between specified points within a time limit.

10. Special carload rates are made for excursions at the lowest rates. The car is permitted to carry a full seated load and usually a limited additional number of standing persons.

Twenty-six interurbans in Ohio, Indiana and Michigan are reported by the *Street Railway Journal* to sell these kinds:

Tickets.	No. of Companies.
Single trip	24
Round trip	24
Commutation (individual)	13
Commutation (family)	11
School tickets	14
Mileage books	10
Interchangeable coupons	15
Sunday	7
Week-end	4
Not selling tickets	2

All the above and many more forms of paid transportation are used in the development of the interurban business. The writer, on undertaking the management of an interurban system, found in use tickets of as many as 400 kinds; that is, differing in form and points between which they were usable.

GRADATION OF RATES.

The gradation of price between these various forms of tickets must follow a consistent sequence in order that each ticket may find its proper use. To illustrate: If the mileage book price is less than the commuter rate, there would be no sale for commuter books. The gradation is commonly something like this: Assume the base rate for a single trip ticket is 2 cents per mile, round trip ticket will be 10 per cent. off, or 1.8 cents; the interline single trip ticket will be the sum of the single trip rates of the connecting roads and the interline round trip ticket will likewise be the sum of the round trip rates of the connecting roads, or less if there is a competitive route; the mileage book will be 16% per cent. off or 1% cents per mile net; the commuter book ticket rate will be about 1.25 cents; the school rate will be 1 cent and the excursion rate and party rate will vary from 0.5 of a cent to 1.5 cents, according to distance, size of excursion and other conditions. This gives a general idea of the consistent relationship between these various rates, but, of course, there are considerable departures from this practice in individual cases.

The average gradation of rates in cents per mile, in three Western states, is shown in figures from the *Street Railway Journal*, May 5, 1905, as follows:

	Issued by Ohio.	Issued by Michigan.	Issued by Indiana.
Cash fare	1.84 23	1.58 5	1.68 8
Single trips	1.77 17	1.48 4	1.68 6
Round trip	1.63 20	1.34 4	1.45 6
Commuters (family)	1.45 12	1.10 2	1.23 3
Commuters (individual)	1.09 17	1.00 2	1.20 5
Mileage	1.37 6	1.25 1	1.22 2
Interline coupons	1.48 10	1.30 1	1.67 1
School	1.03 12	0.87 2	0.94 4

THE ESTABLISHMENT OF RATES.

Mr. C. L. S. Tingley, Vice-President of the American Railways Company of Philadelphia, speaking of Pennsylvania conditions, states:

"The whole thing is a matter of ordinance regulation and not a question of scientific rate making."

This is true for many roads elsewhere.

For the short interurban with the dense traffic, 5 cent zones and no tickets are clearly indicated.

For the long interurban, experience has clearly indicated the expediency of a mileage basis of charge with tickets and a gradation of rates for different classes of travel. The western interurban connection with other interurbans and having steam or electric competitors will need (a) cash receipts for use on the car, (b) single and round trip tickets, (c) interline single and round trip tickets, (d) interchangeable coupon books, (e) commuter or book tickets, (f) school tickets, and (g) excursion tickets. A consistent relation in rates for each kind of ticket has been specified in the preceding sections.

The interline tickets and interchangeable coupon books are required for steam competitors. The commuter tickets are required to build up a travel of wage earners working in one place and living in another. Excursion tickets are required for those who might not otherwise ride, and school tickets are ordinarily an unprofitable concession to education.

The profit from traffic should not be estimated too narrowly on a cents per passenger-mile basis. If a car receives all its load at the terminal and does not pick up passengers along the way, the space taken by the passenger is worth as much whether he rides all or part of the trip; or to make specific application, commuter rates should be determined more by what the passenger can afford from his daily wage and by seat-trip cost than by mileage rates.

Excursion rates and carload rates are subject to the greatest variation and the cost of such business may be figured progressively lower as one in turn omits interest, depreciation, general expense, track maintenance and other items that are not affected sensibly by

the operation of an additional car over the road. If platform wages, power and car repairs are figured as the only cost of the additional service, very low mileage rates may be made. Such reduction of excursion rates is justified within limits to the extent upon which the largest annual receipts may be secured.

A company may make money on excursions at half a cent a mile where it is losing on regular travel at 2 cents a mile. For the same reason, commuter travel at a cent may be a desirable addition to the business where general travel will hardly yield a profit at 1½ cents. By commuters we mean those persons traveling back and forth between work and home every working day. The lower rate enables certain people to take employment in the city when they could not afford to pay fares at full rates out of their daily wage, and enables workmen in the city to move to the country when otherwise they would locate along some city line reached by a 5 cent fare.

Roads differ greatly in regard to the possibilities of commuter travel. On some a large feature can be made of this business; on others, it is not worth while to even put the books on sale. In conclusion we may state the rate which may be profitable for one road may be unprofitable for another and, in each case, the distribution of the population along the road and the character of the travel must be studied carefully to determine the rates charged. The heavier the travel and the more miscellaneous its character, the greater reason for making a uniform and low rate for all classes of travel. On the other hand, the less the density of the population, the greater reason for making an initial single trip high rate for the occasional traveler and creating, in addition, a large regular travel by other forms of lower rate tickets.

In conclusion we may state that, before attempting to fix rates, the first thing is to study the density of the population along the line, and its location, to estimate how much will be through travel, how much short ride travel out of the terminals, how much loading and reloading of passengers will occur in the course of the trip, what pleasure resorts exist, or may be built up, what commuter travel will be created, that is, working people in the city drawn into the country to live, and country people secure employment in the city, and all of these and other elements are more vital in determining the rates of fare than the car-mile cost, trip-seat cost, or the seat-mile cost. In fact, the character of the travel should determine the kind of road built and the choice of rolling stock. After a study of all the conditions a determination must be made of various kinds of tickets to be sold and the gradation of rates between them.

Ticket offices should be established wherever ticket sales will justify it, and in the Middle West about 60 per cent. of receipts are collected through such offices. Reasonable care will insure that such receipts reach the treasury of the company. Tickets have the advantage of keeping money out of the conductors' hands, but, as a considerable amount will be collected by the conductors, it is of vast importance to secure a proper account of it.

West and other sections of medium density of population, a large

Large sums remain to be collected by the conductors on the cars from passengers boarding them where ticket offices cannot be maintained and from passengers failing to buy tickets where they are sold. Every safeguard should be provided for such collections in order to check fully the work of the conductors.

The cash fare receipts issued on the cars should show at least from what point to what point fare is paid, and the auditor's stub must give corresponding information. The tickets and stubs turned in by the conductor will then show how many passengers should be in the car at each point along its trip. An actual count of passengers at one or more points thus affords an exact check on the conductor's returns.

Accident Bulletin No. 24.

The Interstate Commerce Commission has issued Accident Bulletin No. 24, giving the record of railroad accidents in the United States during the three months ending June 30, 1907, and yearly tables for the 12 months ending with June. The number of persons killed in train accidents in the quarter was 250, and of injured 4,124. Accidents of other kinds bring the total number of casualties up to 19,711 (1,065 killed and 18,646 injured). These reports deal only with (a) passengers and (b) employees on duty.

TABLE NO. 1.—Casualties to Persons—April, May and June, 1907.

	Passen- gers.		Em- ployees— (reported)		Tot'l persons (reported)	
	Kil'd.	Inj'd.	Kil'd.	Inj'd.	Kil'd.	Inj'd.
Collisions	7	728	96	991	103	1,719
Derailments	41	1,293	83	673	124	1,966
Miscellaneous train accidents* .....	..	33	23	406	23	439
Total train accidents	48	2,054	202	2,070	250	4,124
Coupling or uncoupling .....	..	..	72	973	72	973
Doing other work abt. trains or switches ..	..	..	76	4,243	76	4,243
In contact with overhead bridges, etc..	1	7	40	377	41	384
Falling from or getting on cars or engs..	49	558	194	3,024	243	3,582
Other causes	13	572	370	4,768	383	5,340
Total (other than train accidents) ..	63	1,137	752	13,385	815	14,522
Total, all classes	111	3,191	954	15,455	1,065	18,646

*Including locomotive boiler explosions.

The quarter ending with June usually shows lighter accident records than any other quarter of the year, and this is generally

true in the present instance; but the principal totals are all larger than in the same quarter one year ago. This may in large measure be accounted for by the marked and constant increase in railroad traffic. The number of passengers killed in train accidents, which fluctuates more than any other item, is very much larger than one year ago; but there is a marked diminution from the high figure reported three months ago. In the present bulletin, derailment No. 6* (Table 2a), killing 33 and injuring 19, and collision No. 1,† killing eight and injuring 37, are the extraordinary items.

Comparison of Principal Items with Last Bulletin and With One Year Back.

	Bulletins		
	No. 24.	No. 23.	No. 20
1. Passengers killed in train accidents	48	126	27
2. Passengers killed, all causes	111	184	81
3. Employees killed in train accidents	202	295	167
4. Employees killed in coupling	72	62	68
5. Employees killed, all causes	954	1,109	852
6. Total passengers and employees killed, all causes.	1,065	1,293	933

The total number of collisions and derailments was 3,777 as follows:

TABLE No. 2.—Collisions and Derailments.				
	No.	Loss.	Persons	
			Killed.	Injured.
Collisions, rear	402	\$472,031	26	419
" butting	228	368,239	45	717
" trains separating	144	63,521	3	44
" miscellaneous	1,032	427,453	29	539
Total collisions	1,806	\$1,331,244	103	1,719
Derailments due to:				
Defects of roadway, etc.	426	\$394,970	13	625
Defects of equipment	821	672,783	15	276
Negligence of trainmen, signalmen, etc.	106	63,682	10	178
Unforeseen obstruction of track, etc.	91	154,640	16	112
Malicious obstruction of track, etc.	11	67,480	3	46
Miscellaneous causes	516	547,874	67	729
Total derailments	1,971	\$1,901,429	124	1,966
Total, collisions and derailments ..	3,777	\$3,232,673	227	3,685

The following, Table 2a, is a list of train accidents in which the damage is reported at \$10,000 or over, and other notable cases:

TABLE 2a.—Causes of Thirty-two Prominent Train Accidents (Class A).

[NOTE.—R., stands for rear collision; B., butting collision; M., miscellaneous collisions; D., derailment; P., passenger train; F., freight and miscellaneous trains.]

COLLISIONS.									
No.	Class.	Kind of train.	Killed.	Injured.	Damage to engines, cars & roadway.	Reference to record.	Cause.		
1	B.	P. & F.	8	37	\$695	91	Disregard of telegraphic orders. See note in text.		
2	M.	F. & F.	0	0	2,100	42	Collision on side track; train moving only 1 mile an hour, but engine man fell asleep and slept 2 minutes; had been on duty 21 hours.		
3	B.	P. & F.	0	13	6,800	11	Eastbound freight encroached on time of westbound passenger train (1 a.m.). Engineman did not know road; had taken this run by making misrepresentation; conductor and 2 brakemen asleep.		
4	B.	F. & F.	1	4	7,000	16	Runaway on steep grade 3 a. m. See note in text.		
5	B.	P. & F.	4	33	8,000	68	Engineman of westbound freight (who was killed) evidently forgot regular eastbound passenger train; passenger train scheduled for only 2 days in the week—Saturday and Sunday.		
6	R.	F. & F.	0	2	10,000	7	Flagman of pushing engine failed to signal following train.		
7	B.	F. & F.	0	5	10,000	45	Operator, 20 years 10 months of age, neglected to deliver meeting order. Cleared signal for another train and forgot to restore it to the stop position.		
8	B.	F. & F.	0	2	10,220	1	Operator, 17 years of age, accepted order after train had left.		
9	B.	P. & F.	4	5	10,400	36	Flagman failed to signal following train; 5 a. m.; foggy.		
10	B.	F. & F.	0	4	10,600	72	Freight train entered yard 1 a. m. with speed not under control.		
11	B.	F. & F.	1	2	10,935	33	Butting collision at water station; engineman asleep.		
12	R.	P. & F.	2	21	12,000	5	Failure of block signaling and flagging. See note in text.		
13	R.	F. & F.	0	2	13,000	9	Runaway, due to failure of air pump; neglect to slacken speed on passing over summit, and failure to apply hand brakes.		
14	B.	P. & F.	1	7	13,000	12	Empty engine encroached on time of passenger train. Engineman's watch slow, not having been wound; engineman's experience as a runner, six months.		
15	R.	F. & F.	0	1	16,000	18	Signal cleared when track was not clear. This was made possible by the breakage of a connection at an interlocking cabin. Signalman held negligent.		
16	B.	F. & F.	6	4	36,670	14	Operator accepted order after train had passed. See note in text.		
17	R.	F. & F.	0	2	56,889	6	Rear collision of freight trains in tunnel. A comparatively light train overtook a heavier one. Time interval at last station 10 minutes. Leading train held blameworthy for not signaling by fusee, and the following train for running too fast. Tunnel lining took fire and was damaged \$50,000.		
Total		27	144		\$234,309				

*Honda, Cal., May 11, *Railroad Gazette*, May 17 and July 12.

†Hartford, Conn., June 23; *Railroad Gazette*, July 26. In this case the conductor and engineer were tried for manslaughter, convicted and sentenced to imprisonment for 9 months.

DERAILMENTS.

No.	Class.	Kind of train.	Killed.	Injured.	Damage to engines, cars & roadway.	Reference to record.	Cause.
1	D.	P.	2	0	\$5,400	31	Excessive speed; engine running tender first.
2	D.	F.	1	2	11,000	52	Spread of rails; roadbed softened by rain.
3	D.	P.	0	26	11,000	86	Unknown.
4	D.	P.	1	20	13,000	51	Track distorted by solar heat.
5	D.	F.	0	0	14,000	82	Broken flange. Derailed cars wrecked a bridge.
6	D.	P.	33	19	14,200	63	Unknown. See note in text.
7	D.	F.	0	1	15,900	88	Unknown; damage due mainly to explosions of naphtha and gunpowder.
8	D.	F.	1	1	19,930	59	Failure of bridge; bridge damaged by blasting near by at the moment the train entered upon it.
9	D.	P.	0	26	20,032	62	Rails maliciously loosened.
10	D.	F.	1	1	25,000	28	Landslide in the night. Inspector had detected no indication of trouble.
11	D.	P.	2	26	30,000	23	Roadbed undermined by water from springs not before known to exist.
12	D.	P.	2	5	32,000	30	Switch maliciously misplaced.
13	D.	F.	1	10	34,000	58	Rock slide; this occurred on an old railroad. It is believed that blasting 1,000 ft. distant had fractured the rock so as to permit vegetation to disintegrate it.
14	D.	P.	0	35	61,224	75	Defective track. See note in text.
15	D.	P.	3	21	84,500	32	Unknown. See note in text.
Total		47	193		\$391,186		
Grand total.		74	337		\$625,495		

Derailment No. 6, by far the worst accident in the present record, causing the death of 33 persons and the injury of 19, is reported as due to some cause undiscovered. A passenger train, running at regular speed, was derailed at a facing point split switch and the two cars next behind the engine were completely wrecked. When these came to rest they were lying close to the engine, so that steam escaping from the boiler scalded the occupants of the cars. The engine appears to have passed over the switch in safety, and the two cars next following evidently were thrown off by the partial movement of the switch. Of the seven cars in the train the two at the rear passed over the switch without being derailed. It would appear that some part of the engine broke and fell to the track, causing the movement of the switch rails, but it was impossible to discover any positive evidence of this. The side track leading from the switch diverged to the left, and the switch rail on the left side of the track was found after the accident in proper position and undamaged. The engine and tender, though they passed over the switch without being derailed, were knocked off the track in some way, presumably by the derailed car next behind them, and the tender was pushed against the engine in such a way as to overturn it. It is possible that the leading truck of the tender was the one that caused the damage to the switch and that first left the track. The switch was fitted with a circuit breaker so adjusted as to set an automatic block signal against an approaching train if the switch point were more than one-quarter of an inch away from the stock rail. This circumstance affords additional evidence that the switch was in proper position when the leading wheels of the engine ran onto it.

Collision No. 1 was between a westbound passenger train and an eastbound work train, and all of the victims were employees, except three passengers slightly injured. All of the eight killed and 32 of the injured were laborers riding in the leading car of the work train, the engine of this train being at the rear end. The collision occurred on a line where, although the railroad is double-tracked, one of these tracks for a few miles is used for suburban trains in both directions and the other one for other trains. On the day in question, which was Sunday, the suburban trains were run on the track usually used by other trains, in order to facilitate repairs on the suburban track. This temporary arrangement was to last from 7 a. m. to 7 p. m. The collision occurred at 6.50 p. m. A supplementary order had just been issued extending the temporary arrangement, but it appears to have been misunderstood. The passenger train was made up on the proper track, but it was run through a crossover to the other track, the conductor adjusting the switch himself, and it proceeded on the wrong track in disregard of the special orders, which were clear and which no one claims to have misunderstood. The collision occurred before the passenger train had run more than a half mile. The conductor of the passenger train is reported as having left for parts unknown soon after the accident.

Collision No. 4, causing the death of a fireman 21 years old and the serious injury of one other trainman, was due to inefficient management of the air-brakes on a heavy freight train descending a 2½ per cent. grade at 3 a. m., the engineman at that time having been on duty about 21 hours. The grade in question is 26 miles

long, and the train had been run safely for 23 miles when the engineman appears to have allowed the speed to increase to such a rate that there was not sufficient time to recharge the air-brake main reservoir. He had made repeated applications of the brakes, and finally was unable to apply them with sufficient force. The train consisted of 18 cars, weighing about 600 tons, and after it became uncontrollable it collided with an engine standing at a water tank. The engineman at fault had been in the employ of this company about two months, but had been an engineman elsewhere three and one-half years and had served as a fireman, before that, for over five years. One of the cars in the train had no air-brakes working, and two others had leaky brake cylinders. Although the engineman had been on duty 21 hours, he avers that he did not feel sleepy. This crew had been assigned to a work train during the day, and the men had had some time to sleep while the engine was at rest waiting for the laborers to load material. The report says that the brakeman on the forward end of this train was intoxicated at the time of the runaway, so that his services were of little or no value in controlling the speed of the train.

Collision No. 12 was due to an erroneous signal given by a block-signal operator and to the failure of the conductor and the rear brakeman of a freight train to flag a following passenger train. The collision occurred at 2.20 a.m. The freight train was standing partly in a yard, and the block-signal operator reported it as having gone out of the block section, thus allowing the passenger train to come on from the block station in the rear, when in fact a part of the freight train had not cleared the block. The signalman, who had been in the service three years, offered the inadmissible excuse that he had been assured by the yardmaster that the block section was clear. The rear brakeman of the freight endeavored to excuse himself by asserting that the conductor had passed the rear end of the train, apparently going to signal the passenger train. The conductor, who had been in the service four years, refused to attend the hearing on the accident. He, as well as the brakeman and the block signalman, was dismissed from the service, as was the engineman also, for not sounding a whistle

miles an hour. The derailment occurred at 1.20 a.m. The wreck took fire from an explosion of illuminating gas, and was destroyed by fire, with the exception of one sleeping car. The report says that the track, which consisted of rails weighing 75 lbs. per yard and sleepers in first class condition, was in good line and surface, and that there were no indications either of a broken rail or of loosened spikes.

YEARLY TABLES.

This bulletin completes the publication of the accident records under the law of March 3, 1901, for six years, and the double-column table (A) gives the aggregates for the year ending June 30, 1907, of the items which are given in Table No. 1 of the quarterly returns. There have been heavy increases in all of the items, except accidents in car coupling and from striking against overhead obstructions. The number of passengers killed and injured in collisions and derailments has increased to an alarming degree. (See Table B, first item.) In this item the very large total reported in 1905 is now exceeded by 17 per cent. The disastrous record of casualties to passengers in train accidents (410 killed) is due in large measure to 10 accidents which caused the deaths of 291 persons. These have been explained in the four quarterly statements. Nine of the 10 accidents occurred in six states—California, Indiana, Kansas, New Jersey, New York, North Carolina—and one in the District of Columbia.

Following is a list of these 10 cases:

Ten Prominent Accidents in the Year Ending June 30, 1907.

Quarter.		Killed.	Injrd.	State.
First ...	Collision—Confusion of dispatcher's orders...	17	56	N. Car.
Second..	" " "Disregard of rules and signals....	43	63	D. of C.
" ..	" " "Neglect in connection with whistle signals.	43	155	Ind.
" ..	Derailment—Defective or unfastened track at drawbridge.	57	36	N. J.
Third...	Collision—Operator failed to deliver meeting order.	32	75	Kan.
" ..	" " "Engineman disregarded bl'k signal	9	8	Ind.
" ..	Derailment—Unexplained	19	149	N. Y.
" ..	Explosion—Unexplained	16	39	Ind.
" ..	Derailment—Misplaced switch	22	116	Cal.
Fourth..	Derailment—Unexplained.	33	19	Cal.

TABLE A.—Summary of Casualties to Persons, Year Ending June 30, 1907.

	Persons carried under agreement, etc. (bb).				Total, (a, b and bb).		Trainmen.		Trainmen (in yards).		Yard trainmen (switching crews).		Other employees.		Total employees.		Total all persons.	
	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.	Kill'd.	Inj'd.
Collisions	193	4,227	16	506	209	4,733	364	2,702	73	850	48	504	82	752	567	4,808	776	9,541
Derailment	159	3,718	26	466	185	4,184	259	1,786	22	218	18	232	31	275	330	2,511	515	6,695
Miscellaneous train accidents.....	15	134	1	19	16	153	84	1,052	4	266	13	160	13	127	114	1,605	130	1,758
Total train accidents.	367	8,079	43	991	410	9,070	707	5,540	99	1,334	79	896	126	1,154	1,011	8,924	1,421	17,994
Coupling or uncoupling .....	..	..	..	..	..	..	88	1,130	57	718	135	1,985	22	115	302	3,948	302	3,948
Other work about trains or switches...	..	..	..	..	..	..	91	8,430	45	3,012	69	3,182	105	3,087	310	17,711	310	17,711
In contact with bridges, structures, &c.	7	31	1	13	8	44	93	797	13	288	23	445	5	61	134	1,591	142	1,635
Falling from or getting on cars or eng.	146	2,044	16	69	162	2,113	319	5,077	120	2,466	206	3,525	145	1,497	790	12,565	952	14,678
Other causes	50	2,096	17	274	67	2,370	209	780	125	372	118	453	1,354	16,345	1,806	17,950	1,873	20,320
Total (other than train accidents).	203	4,171	34	356	237	4,527	800	16,214	360	6,856	551	9,590	1,631	21,105	3,342	53,765	3,579	58,292
Total, all classes	570	12,250	77	1,347	647	13,597	1,507	21,754	459	8,190	630	10,486	1,757	22,259	4,353	62,689	5,000	76,286

signal to notify the rear brakeman to go back with a red signal.

Collision No. 16, causing six deaths and four injuries, occurred at 3 a.m., and was due to wrong information given by a telegraph operator to the train dispatcher. This operator was 18 years 8 months of age, and had been in the service 11 months. The train passed his station at 2.50 a.m., and he made the proper entry in his book; but 10 minutes later, when the dispatcher inquired if that train had passed, the operator, without looking at the book, replied that it had not, whereupon the dispatcher sent an order for this train to meet another one, and a few minutes afterwards permitted the opposing train to proceed from the other station. The operator at fault soon discovered his mistake, but not in time to prevent the collision.

Derailment No. 14 is reported as due to defective track. An eastbound passenger train, running about 35 miles an hour on an easy curve, ran off the track, and the whole train, consisting of an engine and eight cars, fell down a bank about 20 ft. high. As soon as the train left the track a gas tank attached to the bottom of the dining car exploded, setting fire to the train, and all of the cars, except the mail car, were burned up. Another passenger train had gone over this track in the opposite direction about 30 minutes before the occurrence of the accident, and the engineman and fireman of that train say that they felt a slight irregularity in the track, apparently a low joint, but did not deem it dangerous. It is believed, however, that as there was not quite enough ballast in the track on the outside of the curve the rails were thrown out of line by the rear end of the westbound train. One 75-lb. rail, nine years old, was found broken, but it is not certain that this break occurred before the train ran off the track.

Derailment No. 15, causing the death of three passengers and the injury of 19 passengers and two trainmen, is reported as due to some cause unknown. The train consisted of an engine and eight passenger and baggage cars, and it was running at about 50

From Table B, next following, comparisons may be made for the last three years.

TABLE B.—Casualties for Three Years.

	Years ending June 30.			
	1907.		1906.	
	In- Killed.	jured.	In- Killed.	jured.
Passengers: In train accidents	410	9,070	182	6,778
Other causes	237	4,527	236	4,407
Total passengers	647	13,597	418	11,185
Employees: In train accidents	1,011	8,924	879	7,483
In coupling accidents	302	3,948	311	3,503
Overhead obstructions, etc....	134	1,591	132	1,497
Falling from cars, etc....	790	12,565	713	11,253
Other causes	2,116	35,661	1,772	31,788
Total employees	4,353	62,689	3,807	55,524
Total, pass'grs & employees.....	5,000	76,286	4,225	66,709

TABLE C.—Collisions and Derailments for Two Years.

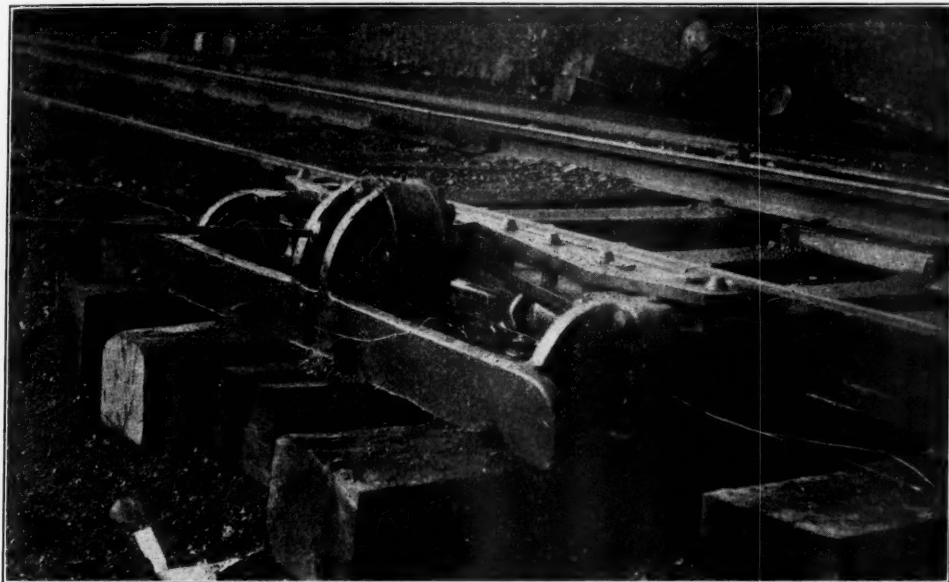
	Years ending June 30.			
	1907.		1906.	
	No.	Persons— Killed. Inj'd.	No.	Persons— Killed. Inj'd.
Collisions, rear	1,957	233 2,423	1,722	169 2,427
" " "butting	1,065	327 3,616	866	251 2,733
" " "train separating	695	13 322	901	9 375
" " "miscellaneous	4,309	203 3,180	3,705	175 2,379
Total collisions	8,026	776 9,541	7,194	604 7,914
Derailments due to:				
Defects of roadway, etc....	1,528	58 1,983	1,287	38 1,608
Defects to equipment	3,178	59 926	2,811	42 502
Negligence train & signalmen, &c.	495	130 756	391	54 494
Unforeseen obstructions, etc....	387	68 658	300	76 456
Malicious obstruction, etc....	59	14 176	65	16 94
Miscellaneous causes	1,785	186 2,196	1,407	147 1,318
Total derailments	7,432	515 6,695	6,261	373 4,772
Total collisions and derailments.....	15,458	1,291 16,236	13,455	977 12,686
Damage to cars, engines, roadway....		\$12,865,702		\$10,659,189

Lateral Thrust of Car Wheels Against the Rail.

BY GEORGE L. FOWLER.

From advance sheets of a report made to the Schoen Steel Wheel Company, and shortly to be published in book form by that company.

It is generally admitted that cast-iron wheels under high capacity cars are giving unsatisfactory service and, because of their inherent lack of strength, are a source of danger. Prior to 1905 little was known of the strength of these wheels except that they had a shorter life and gave far more trouble from flange breakage



Track Apparatus for Testing Lateral Thrust of Wheel Against Rail.

under the high capacity cars than under cars with a capacity of only 60,000 lbs. In that year, Prof. Goss made some tests in the laboratory of Purdue University to ascertain the strength of the flanges of cast-iron wheels.

Six new wheels and one wheel which had broken in service were tested. The wheel to be tested was mounted on a strong mandrel secured to the base of the testing machine in such a manner that it could not slip and a punch was forced down against the flange in the same way that the rail presses against it in service. Pressure was applied until the flange broke. The general arrangement of the apparatus is shown in Fig. 1. The punch A was bolted to the head of the machine. It was prevented from springing away from the flange by a roller bearing against a bracket which was bolted to the platen of the machine.

Three of the wheels tested, Nos. 19,413, 19,410 and 19,254, were new wheels of M. C. B. dimensions. The fourth, No. 10,558, was a piece of a wheel which had broken in service. In addition to these specimens, three new wheels were tested which were especially designed to give increased flange strength. These were marked (e) 650 lbs., (f) 700 lbs. tape 1, (g) 700 lbs. tape 2. Wheels (e) and (f) were the American Car & Foundry Co.'s reinforced flange design and wheel (g) was the then proposed standard of the M. C. B. Association with reinforced flange.

Four tests were made with each of the M. C. B. standard wheels and from two to four tests with each of the others. Three of the tests made on the American Car & Foundry Co.'s wheel (e) showed a flange strength of approximately 100,000 lbs., while the fourth test gave only 68,200 lbs. In view of this wide difference an attempt was made to get a fifth test from this wheel by applying pressure to the flange midway between two of the breaks previously made, with the result that the wheel broke through the rim at 105,000 lbs.

These tests showed that not only were there wide variations in the strength of flanges of wheels of similar design but in different parts of the flange of the same wheel. Reinforcing the flange added to the strength, but even in wheels thus reinforced there was a variation from 68,200 lbs. to 105,900 lbs. in the breaking strength.

These tests cover practically all that is known of the strength of the cast-iron wheel to resist the thrust on the rail. In order to ascertain approximately the relative strength of the steel wheel under similar conditions a Schoen wheel was tested in the same way. The work was done under a powerful hydraulic press and the flange broke off under a load of 526,612 lbs. This was more than 4.7 times the load required to break the strongest part of the flange of the American Car & Foundry Co.'s or the M. C. B. reinforced flange cast-iron wheels and more than 11 times the load required to break the weakest of the M. C. B. plain flanges.

The ratio of 4.7 to 1 corresponds fairly closely with the ratio of the tensile strength of the two metals. The tensile strength

of the steel of the Schoen wheel is about 124,000 lbs. In some tests of cast-iron that have been made it was found that samples of gray iron made from first class wheel mixtures broke at from 16,000 lbs. to 17,000 lbs., while test specimens, carefully ground from the white chilled iron of a car wheel, broke under loads as high as 36,000 lbs.

The total lack of any data on the stresses to which wheels are subjected in service, other than that based on theoretical calculations, necessitated the carrying out of a series of investigations which would throw some light on the subject from a purely practical standpoint. The object of this part of the work was to determine the lateral thrust to which the wheels under high capacity freight cars may be subjected, when moving over curves at different speeds, and, if possible, to develop the law in accordance with which the thrust increases as the speed of the car is increased.

As an investigation of this kind had never before been undertaken, it was necessary to design and build a special piece of apparatus. The method pursued was to place in the track at some point on a curve an instrument which was capable of registering the lateral thrust against the outside rail of each wheel of a car or a train of cars as it passed. To do this it was necessary that the short section of rail which came in contact with the wheel, together with its supports, should have a strength sufficient to sustain the lateral thrust of the heaviest locomotives and that the registering apparatus should be so sensitive and rapid in its action that it would register the thrust of a passing wheel and come back to zero pressure in time to register the next wheel. At the same time, the registering apparatus had to be so light that the effect of the inertia of its moving parts was reduced to a

minimum. The registering apparatus was designed to give a record of each wheel of an ordinary freight car, with a truck wheel base of 5 ft. 2 in., moving at a speed of 40 miles an hour. The interval elapsing between the passage of two such wheels over a given point is .088 sec.

The apparatus as a whole may be divided into two parts: the track apparatus and the recording instrument.

The track apparatus consisted of a section of rail 3 ft. long fastened so that it was firmly held in position in the track and yet was free to move outward by an amount sufficient to exert a pressure on a hydraulic cylinder, in proportion to the lateral thrust against it.

The recording instrument was set on a small table placed about 7 ft. from the track and was connected with the cylinder of the track apparatus by a 1/4-in. brass pipe. It consisted of an ordinary pressure gage, having a maximum registration of 200 lbs.

per sq. in., a recording pressure gage and a pressure pump by which an initial pressure could be put on the whole system of piping. The ordinary pressure gage was made by the Utica Steam Gage Co. and was fitted with a diaphragm spring. It was carefully tested and the dial calibrated before being put in service.

The recording pressure gage was a modification of the Metropolitan recording gage, made by Schaeffer & Budenberg. The clockwork in it was removed and the paper drum driven by hand, so that a record of indefinite length could be obtained. The fact that this paper was driven by hand explains the irregularity of the intervals

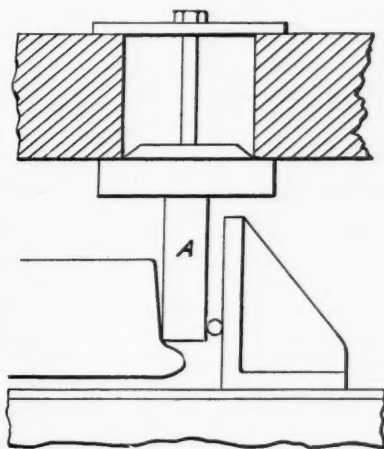


Fig. 1—Method of Breaking Wheel Flanges in Testing Machine.

elapsing between the passage of the several wheels of the cars. This gage also had a maximum registration of 200 lbs. per sq. in. with a pen travel of 4 in., the width of the paper. A Bourdon tube was used as the spring for this gage. It was calibrated for each set of tests by the Utica gage and its indications marked on the paper on which the record was taken.

The piping and all spaces filled with liquid were so arranged that air pockets were entirely eliminated and before work was commenced it was definitely ascertained that the whole

space was completely filled with liquid free from bubbles of air.

The speed of the experimental car as it passed the instrument was registered by means of two trips placed alongside the track and arranged to be struck by one of the journal boxes of the car as it passed. The trips closed an electric circuit passing through one of the coils of a double registering Morse telegraph instrument. When the trip was struck by the journal box, the circuit was temporarily broken and the pen lifted, leaving an opening in the line drawn on the strip of paper traveling through the instrument. The time was indicated by a clock making and breaking an electric circuit at half-second intervals. This circuit passed through the other coil of the register. The two records were made side by side and the intervals between the breaks, on the otherwise continuous line, showed the time elapsing between the striking of the two trips. These trips were spaced 66 ft. apart so that the speed of the passing car could be readily calculated. Specimens of these records are shown in the accompanying engraving, Fig. 2, where the car was moving at 9.14, 13.26, 14.21, 12.81 and 30.61 miles per hour, respectively.

Through the courtesy of the Pittsburgh, Cincinnati, Chicago & St. Louis, facilities were supplied for making this investigation of wheel stresses on the Hickory Branch extending south from Burgettstown, Pa. The instrument was placed in the outer rail near the northern end of a curve of 1,307 ft. radius, or about 4 deg. 25 min. The elevation of the outer rail was $3\frac{1}{8}$ in., which is correct for a speed of 36.66 miles per hour. As the trips for registering the speed could work for only one direction of motion, they were set for the northbound traffic, which was the direction of the loaded trains. At the point where the records were taken the car was well in on the curve, with the trucks set in the normal position, and all the elements of entering the curve were removed. It may be added that the curve had no easement at either end.

On the approach of a train, or the experimental car, an initial pressure was put on the piping system, in order that the movement of the registering pen might be reduced to a minimum and with it the effect of the inertia of the parts. This initial pressure was varied according to the speed. In operation, the actual movement of the floating rail was imperceptible. The levers divided the actual movement by five at the diaphragm, which yielded only enough to take the expansion of the Bourdon tube and the diaphragm of the pressure gage, when delivering from a cylinder 6 in. in diameter.

Records were taken of a number of passing trains, and also a special series of measurements was made with a loaded coal car run at different speeds over the apparatus. Some of the records are shown in the accompanying diagrams, Figs. 3 and 4.

In the records of the loaded coal trains, taken as they passed, no memorandum of the weights of the cars was obtained. The weights were, however, approximately the same, and yet there were wide variations in the lateral thrusts of the wheel against the rail. For example: In the train moving at 9.35 miles per hour, these thrusts varied from 2,260 lbs. to 7,210 lbs., with an average of 4,835 lbs. On another train, moving at 12.05 miles per hour, the thrust varied from 7,070 lbs. to 10,605 lbs., with an average of 8,205 lbs.; while on another, moving at 4.04 miles per hour, the average was 5,543 lbs., with a range from 4,450 to 6,635 lbs. In one case a car registered a thrust of 16,175 lbs. when moving at 14.35 miles per hour. This wide variation in the lateral thrust of different cars in the same train at the instant of passing the apparatus was still more strikingly shown in the series of tests made with a single car.

The tests with a single car consisted of 33 runs over the apparatus, at speeds varying from 4.57 to 31.25 miles per hour. The car used was a hopper-bottom coal car, No. 210,512, of 100,000 lbs. capacity and weighing, when empty, 39,500 lbs. It was designated as of the G1 class by the Pennsylvania Lines West. The total weight of the car loaded with coal was 142,300 lbs.

This car, after being started some distance from the apparatus, was cut loose from the engine and allowed to drift over the track instrument. The accompanying table gives the records that were made.

The column headed "Wheel No." indicates the order in which the wheels passed over the apparatus. Thus: 1 indicates the front wheel of the forward truck; 2, the second wheel; 3, the front wheel of the rear truck, and 4, the rear wheel. The blank spaces in the column of lateral thrust indicate no record obtained, because of the fact that the initial pressure put on the apparatus was greater than the wheel thrust, so that the thrust produced no movement of the pen. Throughout the whole series of tests the weather was fine and the rail dry.

For convenience of reference and comparison, the lateral thrusts of the front wheel of the forward truck have been plotted on the accompanying diagram, Fig. 5. This diagram shows graphically the wide variations in the lateral thrust of the wheel. From it, it is impossible to deduce any positive ratio between the speed and the thrust, but it shows that there is a relationship and that the higher the speed the greater the thrust. There are a number of records for the first wheel, extending from about 9.60 miles an hour to 16.21 miles an hour that lie in a straight line drawn

from just below the record of 31.25 miles an hour of 10,035 lbs. The line drawn through these points is represented by the equation:

$$T = 333 V - 800$$

in which

T = Lateral thrust of wheel in lbs.
 V = Speed in miles per hour.

This must be regarded as a tentative formula only and one which evidently will not hold for very low speed. But from the records that have been obtained, it gives the lowest values and therefore it cannot be criticized as being too high.

Attention is also called to the fact that the pressure seems to increase directly as the speed and not as the square of the speed which is the rate of increase of the centrifugal force. The prob-

Test No.	Speed, m. p. h.	Wheel.	Lateral thrust, lbs.	Test No.	Speed, m. p. h.	Wheel.	Lateral thrust, lbs.
1.	4.57	1.	2,470	18.	13.26	1.	8,055
1.	4.57	2.	1,415	18.	13.26	2.	7,775
1.	4.57	3.	1,695	18.	13.26	3.	7,635
1.	4.57	4.	1,415	18.	13.26	4.	6,645
2.	7.63	1.	1,695	19.	13.66	1.	10,460
2.	7.63	2.	1,415	19.	13.66	2.	7,490
2.	7.63	3.	1,415	19.	13.66	3.	.....
2.	7.63	4.	.....	19.	13.66	4.	.....
3.	10.43	1.	2,545	20.	13.27	1.	7,210
3.	10.43	2.	1,770	20.	13.27	2.	6,645
3.	10.43	3.	1,695	20.	13.27	3.	6,500
3.	10.43	4.	1,695	20.	13.27	4.	.....
4.	7.39	1.	2,400	21.	16.21	1.	4,665
4.	7.39	2.	1,415	21.	16.21	2.	.....
4.	7.39	3.	1,415	21.	16.21	3.	6,220
4.	7.39	4.	1,415	21.	16.21	4.	.....
5.	8.57	1.	2,120	22.	18.00	1.	7,210
5.	8.57	2.	1,270	22.	18.00	2.	6,645
5.	8.57	3.	1,415	22.	18.00	3.	.....
5.	8.57	4.	1,415	22.	18.00	4.	.....
6.	8.20	1.	1,840	23.	17.58	1.	6,785
6.	8.20	2.	1,415	23.	17.58	2.	6,360
6.	8.20	3.	1,415	23.	17.58	3.	7,775
6.	8.20	4.	1,415	23.	17.58	4.	6,645
7.	9.60	1.	1,695	24.	14.21	1.	9,895
7.	9.60	2.	1,415	24.	14.21	2.	9,470
7.	9.60	3.	1,270	24.	14.21	3.	10,320
7.	9.60	4.	.....	24.	14.21	4.	8,480
8.	10.21	1.	3,250	25.	10.91	1.	2,825
8.	10.21	2.	3,110	25.	10.91	2.	.....
8.	10.21	3.	4,240	25.	10.91	3.	3,110
8.	10.21	4.	3,250	25.	10.91	4.	.....
9.	9.60	1.	3,535	26.	18.46	1.	10,320
9.	9.60	2.	3,535	26.	18.46	2.	9,190
9.	9.60	3.	4,240	26.	18.46	3.	10,605
9.	9.60	4.	3,195	26.	18.46	4.	10,320
10.	9.60	1.	3,535	27.	21.81	1.	4,950
10.	9.60	2.	3,250	27.	21.81	2.	.....
10.	9.60	3.	4,380	27.	21.81	3.	7,490
10.	9.60	4.	3,250	27.	21.81	4.	5,230
11.	15.62	1.	3,110	28.	19.03	1.	16,785
11.	15.62	2.	2,970	28.	19.03	2.	.....
11.	15.62	3.	2,970	28.	19.03	3.	7,350
11.	15.62	4.	2,400	28.	19.03	4.	5,090
12.	11.00	1.	4,950	29.	25.10	1.	5,655
12.	11.00	2.	4,240	29.	25.10	2.	5,655
12.	11.00	3.	3,960	29.	25.10	3.	5,655
12.	11.00	4.	3,815	29.	25.10	4.	3,675
13.	16.55	1.	4,525	30.	25.10	1.	10,745
13.	16.55	2.	3,535	30.	25.10	2.	9,330
13.	16.55	3.	4,525	30.	25.10	3.	10,180
13.	16.55	4.	3,395	30.	25.10	4.	9,615
14.	14.18	1.	3,815	31.	27.91	1.	10,605
14.	14.18	2.	3,535	31.	27.91	2.	9,895
14.	14.18	3.	5,935	31.	27.91	3.	9,615
14.	14.18	4.	4,665	31.	27.91	4.	.....
15.	12.63	1.	3,393	32.	31.25	1.	10,035
15.	12.63	2.	3,250	32.	31.25	2.	8,200
15.	12.63	3.	4,857	32.	31.25	3.	11,025
15.	12.63	4.	3,250	32.	31.25	4.	7,775
16.	13.33	1.	4,810	33.	30.61	1.	12,445
16.	13.33	2.	4,810	33.	30.61	2.	11,310
16.	13.33	3.	7,350	33.	30.61	3.	12,865
13.	13.33	4.	5,800	33.	30.61	4.	9,190
17.	9.14	1.	6,645				
17.	9.14	2.	5,655				
17.	9.14	3.	4,950				
17.	9.14	4.	4,240				

able reason for this is that none of the speeds recorded were equal to or exceeded the speed corresponding to the superelevation of the outside rail. Therefore, centrifugal action has no effect. In running around a curve, the car must be deflected from the tangent at a certain rate, and this requires a certain definite amount of power. If, then, this power is exerted in a short period of time, a higher pressure will be put against the rail than if the time was longer, and, therefore, the pressure will vary inversely as the time. So that if the car passes around the curve in half a minute, the pressure will be twice what it would be if a minute was required. Hence, the pressure at 30 miles an hour would be twice that at 15 miles an hour.

When the speed exceeds that for which the superelevation is

calculated, centrifugal action will then begin to manifest itself, and there will then be a more rapid rise of pressure than would be found from the equation given above. This additional increase would be in the ratio of the square of the speed. For example: At a speed of 36.66 miles per hour, the centrifugal effect is balanced by the superelevation of the outer rail on the curve on which these investigations were made. At 40 miles per hour, the centrifugal force is 1.19 times as great, and this 19 per cent. additional manifests itself as additional lateral thrust above that called for by the formula.

Taking the car under consideration, weighing 142,300 lbs., the

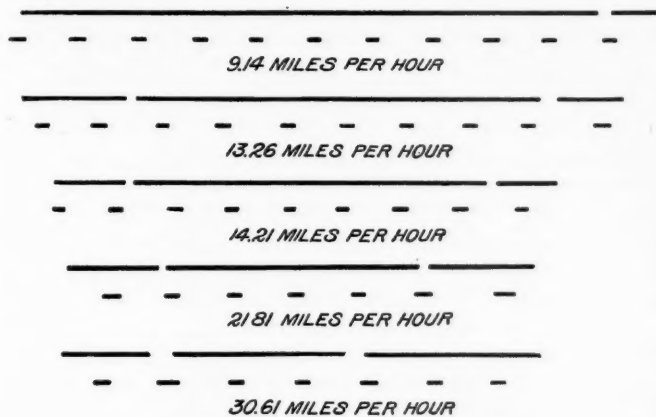


Fig. 2—Time and Speed Records.

centrifugal action would be 9,648 lbs. at 36.66 miles per hour; 11,481 lbs. at 40 miles per hour, and 14,568 lbs. at 45 miles per hour. The excess centrifugal force to be distributed among the four wheels of the car at 40 and 45 miles an hour would be, therefore, 1,733 lbs. and 4,920 lbs. respectively. If 25 per cent. of this is taken by the front wheel, which is a low estimate of what would actually be imposed, there would be an extra load of 433 lbs. and 1,230 lbs. added to the stress given by the formula for that imposed on the front wheel. This then becomes

11,408 lbs. at 36.66 miles per hour.
 12,953 lbs. at 40 " " "
 15,415 lbs. at 45 " " "

It must be remembered that these are minimum values, and that blows due to soft spots in the track, kinks in the curve, bent rails, low joints and cramped side bearings will greatly increase

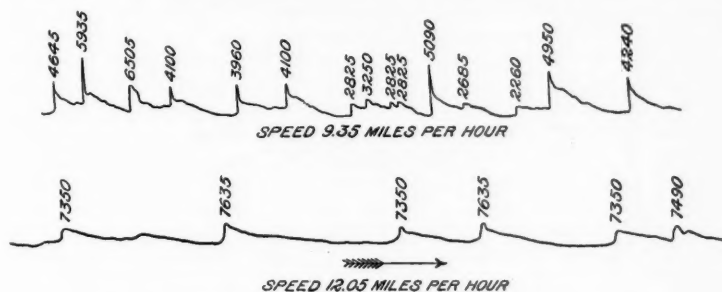


Fig. 3—Parts of Records from Passing Trains.

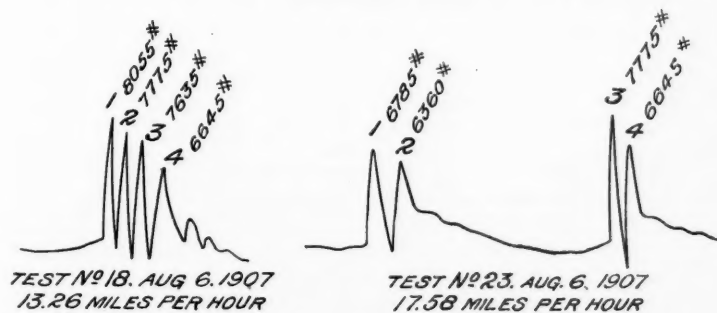


Fig. 4—Typical Records of Experimental Car.

this thrust. Sufficient data, however, has not yet been obtained to warrant any estimate of how much this increase would be. The diagram shows that stresses far above those found from this tentative formula are imposed on the wheels.

The extreme case occurred in test No. 19, where the thrust was 10,460 lbs. in excess of that found from the formula. If the blow or cramping which caused this excessive thrust at 13.66 miles per hour was to occur at a speed of 45 miles per hour, the thrust that might be expected would be 20,886 lbs., and if it were to be increased in proportion to the speed it would become more than

36,000 lbs. This may be an extreme and exceptional case, but the results obtained seem to indicate that at least as great a stress as this should be provided for.

Referring again to the tests of flange strength made in 1905 by Prof. Goss, in the 23 tests that were made, the pressures required to break the flange ranged from 47,750 lbs. to 109,900 lbs., with an average of 80,440 lbs. This gives a possible factor of safety of a little more than 2.5 when the maximum stress is taken at 30,000 lbs., and the average strength at 80,000 lbs., but it drops to a little more than 1.5 when the strength of the weakest wheel is taken as the basis of comparison. This is for new wheels. When they have become somewhat worn, the strength of the flange is less and the factor of safety is decreased still more. If this loss of strength in the old wheel is taken at 10 per cent., because of metal worn away, the strength of the weakest wheel used in the tests referred to would be 42,975 lbs., and this would allow a factor of safety above a maximum load of 30,000 lbs. of about 1.4.

In this comparison it has been assumed that a car of 100,000 lbs. capacity will deliver the maximum thrust to the wheel on a $4\frac{1}{2}$ deg. curve at 45 miles per hour. This assumption was made because the data was obtained from such a curve. It is evident that greater stresses would be imposed on curves of sharper radius. The outer thrust, where centrifugal action is eliminated, would probably vary inversely as the radius of curvature. There is no data, as yet, to support this position, but it appears probable. If, on further investigation this relation is found to hold, then, instead of a thrust of 12,520 lbs. being put on the wheel, as in the case of a car moving over the 4 deg. 25 min. curve at 40 miles an hour, there will be a thrust of nearly 22,800 lbs. when the same speed is maintained

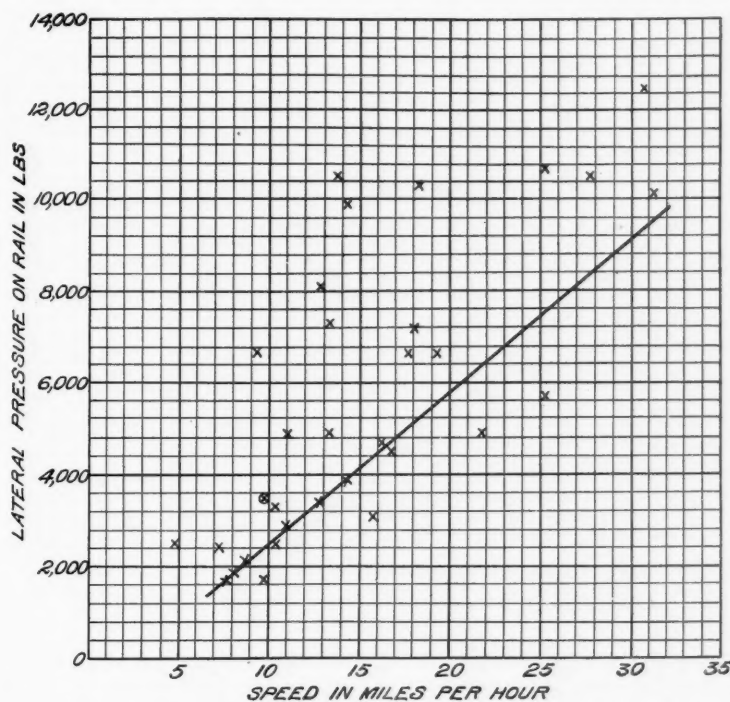


Fig. 5—Diagram Showing Relation of Thrust and Speed.

over a curve of 8 deg. To this must be added the extra stresses that may be set up by blows, cramping of the wheels between the rails, the binding of side bearings and other causes which may result in an increase in the normal stress.

But one weight of car and one arrangement of wheel base has been here considered. There is, as yet, no data to give any idea as to the effect of weight, its distribution on the wheels or the height of the center of gravity, all of which are undoubtedly important.

On the other hand, in this discussion, the whole lateral thrust is considered as resisted by the flange. Under ordinary running conditions this is not the case, for the frictional resistance of the tread of the wheel on the rail must be subtracted from the total thrust. In the car under consideration, the weight on the front wheel was 17,900 lbs. If the coefficient of friction is taken at 0.25 then 4,475 lbs. should be subtracted from the pressure given. This would reduce the maximum pressure, as it had been calculated for a speed of 45 miles per hour, to 31,525 lbs. and the probable minimum to 10,930 lbs. It must be remembered, however, that the frictional resistance is apt to fail suddenly, and that, at all speeds, even where the frictional resistance of the tread on the rail is greater than the lateral thrust, there must be a pressure on the flange in order to effect the deflection of the car on the curve.

In this comparison the front wheel of the leading truck only has been considered because it is on this wheel that the heaviest lateral thrust is imposed. The table shows that, in general, the maximum lateral thrust is on the first wheel; the thrust on the

second is less; on the third it falls between the first and the second, and on the fourth it is the lowest.

In considering the advisability of using cast-iron wheels under high capacity cars, it should be borne in mind that the cast-iron wheel averages approximately one-half the life under the cars of 100,000 lbs. capacity that it does under cars of 60,000 lbs. capacity. The use of the heavy braking pressure on long grades has been the cause of many failures, because of the additional strains set up due to the heating by the brake-shoe. There is a consequent expansion of the rim, and the actual resisting strength of the flange is lowered below that shown in the laboratory tests, which were made with the wheel cold and the metal at its maximum strength. Roads having long, steep grades usually have numerous sharp curves also, and the wheels are likely to be subjected to the most severe stresses when they are least able to resist them. If the lateral thrust on the flanges of wheels, under a loaded car of 100,000 lbs. capacity runs up as high as 30,000 lbs., and the actual breaking strength of the flanges of cast-iron wheels varies from 45,000 lbs. to 105,000 lbs. under the most favorable conditions, the question may be asked whether it is safe to use cast iron wheels under cars of 100,000 lbs. capacity, especially when the breaking strength is likely to be greatly reduced by wear and brakeshoe heating? The answer to this question depends on what the railroads consider the proper factor of safety and legitimate risk in such work.

Proposed Enlargement of the Kaiser Wilhelm Canal.

The present dimensions of the Kaiser Wilhelm Canal, connecting the North Sea with the Baltic, no longer meet the needs of commerce. To make the canal adequate, not only for the present traffic but also to care for any future advances in shipbuilding, the following enlargements are proposed:

The locks are to be changed so as to permit the passage of vessels up to 984 ft. long and of corresponding draft and beam. The proposed dimensions are: length between gates, 1,083 ft.; width, 147½ ft.; depth at mean water level of canal (the same as mean water level of the Baltic Sea), 45 ft. Even at low water this depth would be 39 ft. The present canal profile at mean water level is 29 ft. 6 in. deep, 72 ft. wide at bottom, 220 ft. wide at the surface of the water. The change proposed will make it 36 ft. deep, 144½ ft. wide at bottom, and 334 ft. wide at the surface of the water. The area of the water cross-section will be increased from 4,307 sq. ft. to 8,613 sq. ft.

The line of the canal will not be materially altered. In two places it will be necessary to replace curves of a radius of 3,935 ft., which are no longer safe for modern steamships, by curves of 5,866 ft. radius, the width of the normal profile being increased at the same time. The number of passing stations is to be increased, and they are to be placed about 6 miles apart. The normal cross-section is to have a width of 440 ft. at the bottom and 624 ft. at the surface of the water. Four of these passing stations are to be expanded to serve as turning stations with a length of 3,919 ft., a width at bottom of 538 ft., and at the surface of 722 ft., and they will be connected with turning basins of 984 ft. diameter.

The Relation Between the Condition of Motive Power and Its Repair.

BY CLIVE HASTINGS.*

The life of a locomotive between shoppings may be likened to the span of a man's life, if we consider that each engine mile corresponds to each year of life. The number of years a man's condition would warrant his life expectancy to equal, added to his present age, should equal the average span of life. Any difference in this may be due to two causes: (1) The estimate of his life expectancy is not correct, or (2) his condition is not what it should be for his age, due to the manner in which he has lived or the constitution he may have inherited.

The laws of life expectancy and average age are so constant that life insurance companies with safety stake fortunes on them. An insurance company must know a man's age and also subject him to a medical examination to determine his condition.

So with locomotives. The man or master mechanic in charge of a number of these engines should know:

1. The miles each engine has made since last shopping (this corresponds to the man's age).
2. The general condition the engine is in (this corresponds to the doctor's report).
3. The miles the engine is in shape to make before it must go to the back shop (this corresponds to life expectancy).

Miles between shoppings for separate engines will vary from

*Mechanical Department, A., T. & S. F. Ry.

the average the same as the length of life of the individual man will vary from the average span of life.

Engine repairs may be divided into two classes:

1. Running and Light Repairs.—This class of repairs should include all minor and other repairs which do not include going over the entire engine and putting every part in as good condition as when new. The major part of this class of work should be done in the roundhouse.

2. Complete Overhauling.—This class of repairs is such that when properly done each part, and therefore the whole engine, is as good as new, except for depreciation. This work is done in the back shop.

When an engine is in shape to make the maximum miles expected between complete overhauls, that engine is in first class condition; and when an engine is in such shape that it cannot make another mile before receiving a complete overhauling, that engine

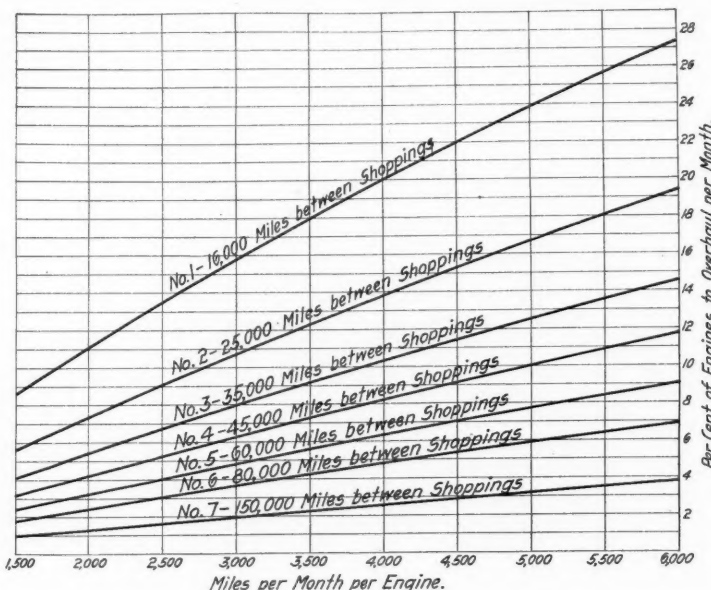


Fig. 1—Chart Showing Percentage of Locomotive Power to be Repaired Each Month So as to Maintain Efficiency of Total Power.

is in zero condition. It is desirable to have all engines as near first class condition as possible, but as on any division there will be some engines just from the shop, others just ready to go into the shop and others in all the intermediate stages, it is impossible to have every engine in first class condition. With a steady flow of engines through the shop there will be an even variation in individual engine conditions, varying all the way from those in shape to make the total miles expected between shoppings to those ready for the shop. The average miles that all engines of a particular class and service will be in shape to make should therefore be one-half the total miles expected of the individual engine between shoppings. This is standard condition and is really one-half of the impossible state of having each and every engine in first class condition.

It should be borne in mind that "condition" used in this sense does not have reference to the efficiency of the engine. Fifty per cent. condition does not mean 50 per cent. efficiency. Engines may have made almost the total of the miles possible to make between shoppings and still be in shape to haul full tonnage. Such engines would be considered good engines by the operating department, yet measured on the basis mentioned they would be in very low condition. The term "degree of wear" probably expresses more nearly what is meant by "condition of power." If the "degree of wear" is assumed to vary from 200 per cent. in the case of a new engine to 0 per cent. in the case of an engine ready for the shop, this term may be used as synonymous with "condition of power" in this article. The department having in charge the maintaining and shopping of engines is concerned with degree of wear. The department having in charge the moving of trains is concerned not with degree of wear, but with engine efficiency.

Standard condition, or 100 per cent., then exists when the average miles the engines on a division are capable of making is equal to one-half the miles expected from the individual engine between shoppings. The average miles the engines are in shape to make is a measure of the condition, hence to determine condition of power in per cent., divide the average miles all the engines are in shape to make before next shopping by one-half the miles expected of the individual engine between shoppings.

The miles the engines are in shape to make before shopping should be estimated by the master mechanics and road foremen. As a check on the estimate we have the actual record of miles al-

ready made since shopping. The sum of the miles an engine has already made and the miles the engine is estimated to be good for, should approximate the miles expected between shoppings. If several engines are under consideration the same applies to averages. On a division on which we expect to get 50,000 miles between shoppings out of each of a certain class of engines, an individual engine may have made 30,000 miles. If the estimate of the miles that engine is still good for is 20,000 miles we have a very close check that a proper state of affairs exists. If the sum of the average miles made and average miles good for is less than miles to be made between shoppings, it shows that the engines have not received proper treatment either in the roundhouses or on the road since last shopping (wrecks can be considered in this connection as improper treatment). If this sum is more it shows that the master mechanic, in his desire to make a good showing, has probably estimated more than he can do, or it may mean that the standard set for total miles to be made between shoppings is too low.

To determine the number of miles that should be made between shoppings it is possible to go over past records, and also take the personal opinion of division mechanical officers. The division officer will almost without exception set the mileage that his engines should make between shoppings higher than the past records will show he has attained. His figure, however, will usually be a good one to take, as it will more nearly represent what should be done than the figure obtained from past records.

The percentage of engines that should be shopped each month is a figure that can be determined to a mathematical nicety. A certain number must be shopped to make up for wear and tear. If condition of power is below standard, or 100 per cent., a greater number should be shopped so as not only to make up for wear and tear, but to improve condition also. The number of engines it is necessary to shop for complete overhauls per month depends upon two things: (1) The number of miles made between complete overhauls per engine, and (2) the number of miles made per month per engine. The more miles made between shoppings, the fewer engines it is necessary to shop per month. The more miles the engines run per month the faster they wear out, hence the more must be shopped per month.

The total number of engine miles made per month on any

gines coming from the shop in any month are capable of making are more than the engine miles used on the division during the month, the balance has been increased or condition of power has been raised; but if the miles which engines coming from the shop in any one month are capable of making are less than the engine miles used on the division during the month, the balance has been decreased and condition of power has been lowered.

The accompanying chart, Fig. 1, shows the relation between miles made between shoppings, miles made per month and percentage of engines that must be shopped each month to maintain the condition the same at the end as at the beginning of the month. This chart can be used in several ways. For example:

1. If it has been decided what mileage should be made between shoppings and what mileage should be made per month, it is possible from the chart to determine what percentage of the engines should be given complete overhauls per month.

2. If it is known what mileage engines have averaged per month and what percentage have received complete repairs during the month, the chart can be used to determine what mileage is being made between shoppings.

These matters have to do entirely with complete overhauls in back shops. The result of neglecting running and light repairs will be to reduce the miles made between shoppings, thus rendering figures based on a fair mileage between shoppings of little use. Checks as to whether running and light repairs are being maintained are:

1. Actual records of miles made between complete repairs. If the proper mileage is not made between these shoppings it is due to lack of running and light repairs.

2. The number of engine failures. Running and light repairs have more to do with failures than condition of power.

3. The amount of money being spent on this class of repairs. These repairs cannot be kept up unless a reasonable amount is spent on them.

Per cent. of condition of power is then an accurate figure, obtained by dividing the average miles engines are in shape to make before next shopping period by one-half the mileage expected of the individual engine between shoppings. Number of engines to shop each month can be determined by dividing total engine miles made by average miles per engine between shoppings. If condi-

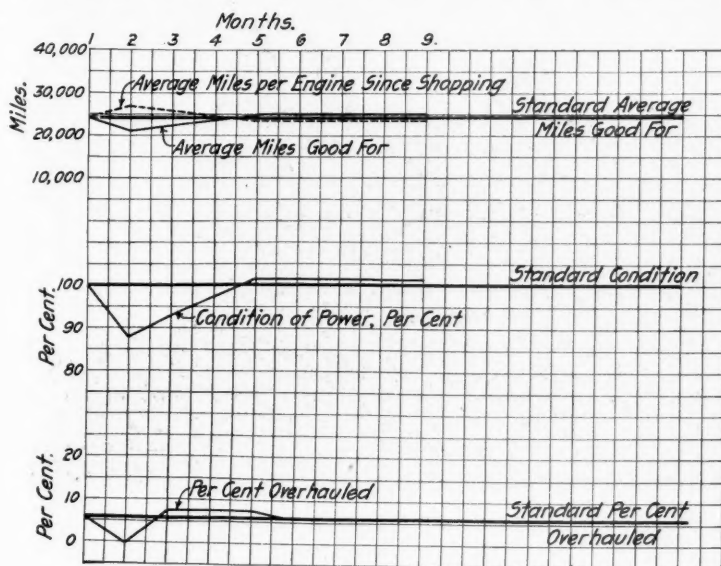


Fig. 2—A., B. & C. Division.

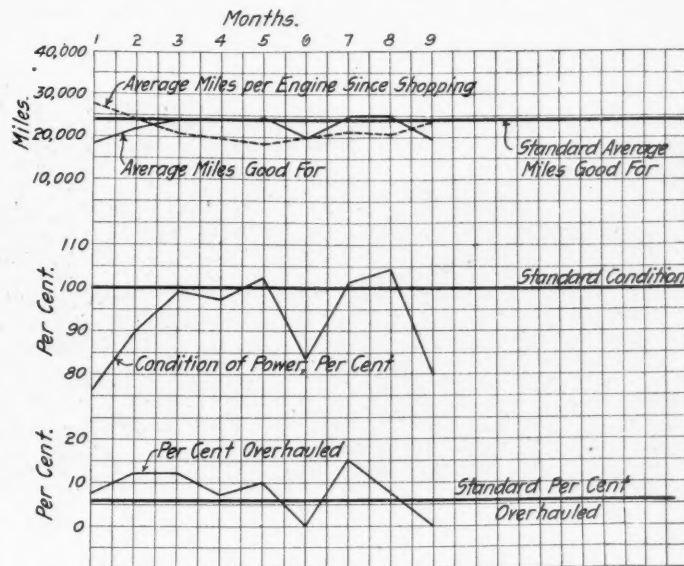


Fig. 3—X., Y. & Z. Division.

Condition of Power on First Day of Each Month; Freight Service.

division, divided by the average number of miles made per engine between complete overhauls, will give the number of engines which it will be necessary to get from the shop each month in order to maintain power. This may be illustrated by considering that the miles all the engines are capable of making before their next shopping are like the working balance of a bank account. Each mile can be treated as one dollar. When condition of power is standard, or 100 per cent., the working balance is a satisfactory amount. Every time an engine runs a mile it is like drawing a dollar from the bank balance. Conditions are not satisfactory when this working balance is less than the standard amount. As the engines on the road use miles the account is depreciated. The only way to replace those spent is by adding to the account the miles which engines coming from the shop are good for.

If the miles which engines coming from the shop in any one month are capable of making before next shopping are equal to the engine miles used on the division during the month, the balance has been maintained and condition of power is the same at the end as at the beginning of the month. If the miles which en-

tion is below standard a greater number must be shopped in order to bring condition up; or if condition is above standard, less may be shopped, thus allowing condition to fall. This method is systematic. The method of running engines until they fall down, then crowding them into the nearest shop, is not systematic. The division mechanical officer who, because his power is in fair shape, is not shopping the correct number of engines and maintaining this fair condition, is following a course which will lead to low condition of power, and necessarily to a high percentage in the shop in order to again bring the condition up to the point desired.

Thus the matter of condition of motive power and the laws for timely shopping of same may be reduced to a rational mathematical basis quite like life insurance. Individual engines and individual men may not follow the laws, but groups of engines and groups of men will be found to do so exactly.

Fig. 2 herewith illustrates the condition of power on a division which keeps very close to standard conditions. The broken line in the top record, or graph, represents the average miles run per engine since shopping for repairs costing \$500 or over. The light

full line represents the average miles-good-for per engine on the first of each month as estimated by the master mechanic.

The light line in the middle graph of the figure represents the condition of power in per cent. determined by dividing the average miles-good-for by the standard average miles-good-for. The heavy line shows the standard condition, 100 per cent.

The lowest graph shows the percentage of total number of engines assigned which are repaired each month. The standard is 5.9 per cent., represented by the heavy line.

Engines in freight service on these divisions should make 3,000 miles per month, and 48,000 miles between shoppings costing \$500 or over.

During the second month no engines were overhauled on account of unusually heavy traffic. As a result the average miles-good-for dropped and the condition of power went down 12 per cent. It was necessary to overhaul almost 2 per cent. more than the standard for three successive months in order to get the condition of power to where it should be. Aside from that one month the conditions are practically ideal.

Fig. 3 illustrates the condition of power on a division having a poor and irregular record. The mileage lines remain low because the mileage was not being made by the engines between shoppings. Only by repairing each month a larger number than the standard was it possible to keep the condition of power at all near 100 per cent., and even then only spasmodically. The failure of the shop to overhaul any engines in the sixth month brought about the same results as shown in Fig. 2.

Completing the Simplon Tunnel.

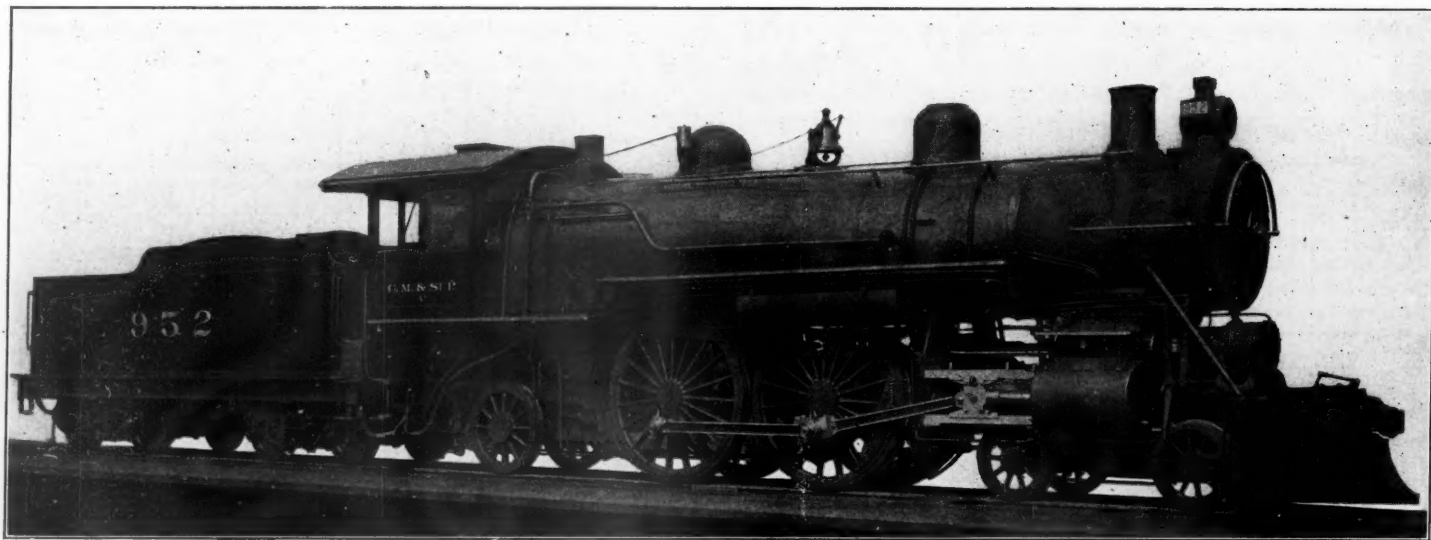
The general directorate of the railroads of the Swiss Confederation has reported to its executive council recommending the completion of the second Simplon tunnel in the near future. The plan for tunneling the Simplon provided for two parallel tunnels connected by cross cuts. One of these tunnels is finished and in operation, while the second is driven through in the rough. The object of the second tunnel was to provide for a second track and also

to furnish better ventilation. In its present incomplete condition at some points the floor has been forced up and falls of rock have occurred from the roof and from the sides. The principal reasons urged in favor of the prompt completion of the second tunnel are: That where heavy pressure and movement of the rocks in the second tunnel make lining of the present cross-section necessary, it will be better economy to complete the tunnel to the full cross-section rather than put in heavy temporary masonry, which would have to be removed in a few years if the completion is postponed. In a long, narrow tunnel in which the movement of trains occupies 20 hours of the 24, there is considerable difficulty in carrying on the work of repairs and of maintenance. Even with the use of electric power, under the existing conditions of moisture, the life of the 100-lb. rails used cannot be more than 10 to 12 years. As replacement of rails in the Simplon tunnel cannot be made more rapidly than at the rate of $1\frac{1}{2}$ to 2 miles a year, it will be necessary to begin the work of replacement under present conditions at the end of 6 or 7 years. The heavy pressure to which the masonry of the completed tunnel is subjected at some points, and the action of the hot waters on the mortar will before long make repairs necessary. With a single tunnel these can only be made during a stoppage of traffic or at an exceedingly heavy expense. They would be materially simplified by having the use of a second tunnel.

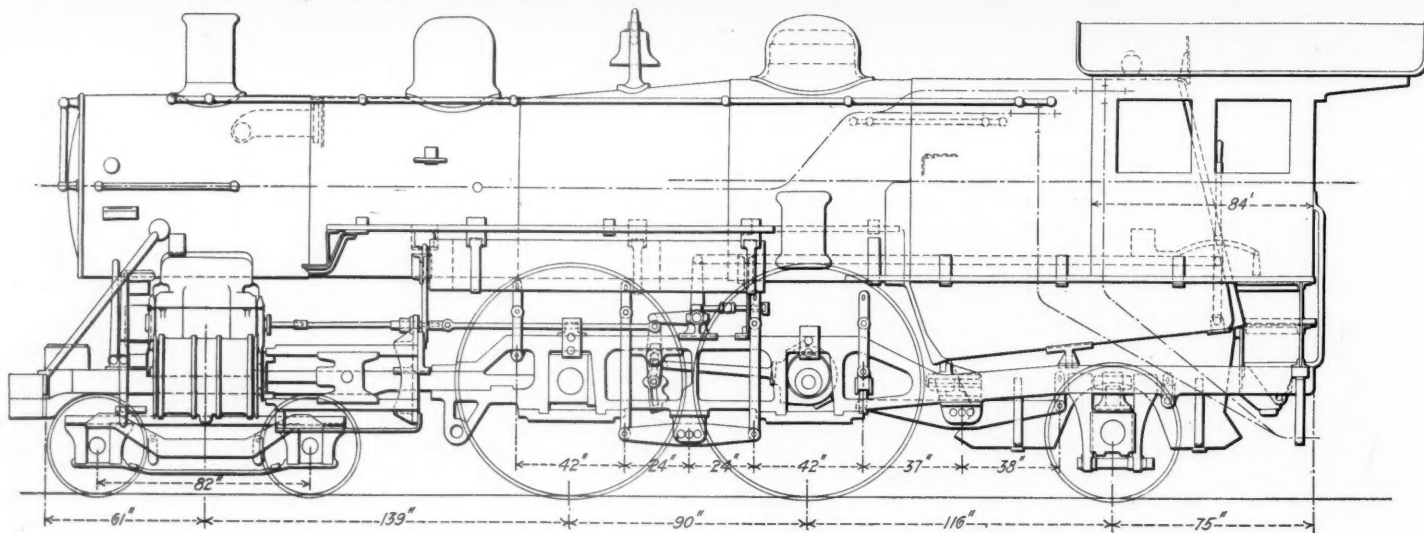
Balanced Compound Atlantic Locomotive for the Chicago, Milwaukee & St. Paul.

The Baldwin Locomotive Works has recently built two balanced compound locomotives for the Chicago, Milwaukee & St. Paul. These engines are of the Atlantic type, and have a tractive power working compound of 22,200 lbs. They will be used in fast passenger service. The maximum curves which they will traverse are of 20 deg. radius.

The principal features of the design are shown in the photograph and drawings. The cylinders are located in the same horizontal plane, and the four main rods are all connected to the leading pair of driving-wheels. With this arrangement the guides are all of the same length. They are supported by cast-steel bearers



Baldwin Four-Cylinder Balanced Compound Atlantic Locomotive; Chicago, Milwaukee & St. Paul.



Baldwin Compound Atlantic Locomotive; Chicago, Milwaukee & St. Paul.

which are bolted to a heavy cross tie. The crank axle is of the built-up type, with cast-steel central web. The driving tires are secured by retaining rings.

The Stephenson link motion is used in this design, with eccentrics placed on the second driving axle. The eccentric rods are straight and the link blocks are connected directly to the rock shafts. The long valve rods are placed above the frame center lines; they are supported by the guide bearer knees, and are provided with knuckle joints to avoid springing. The valves are of the piston type, 15 in. in diameter, and working in cast-iron bushings.

The main frames are of cast-steel 4½ in. wide, with single front rails of wrought iron. Above the rear truck wheels the frames are in the form of slabs, 2¾ in. wide by 10 in. deep. Bosses are cast on the frame ahead of the leading pair of driving-wheels, thus providing supports for the driver brake shaft. The brake cylinder is placed immediately back of the front bumper, and the brakes are operated by a push rod which passes through a 3¼-in. hole located on the center line of the cylinder saddle. This arrangement avoids the necessity of placing the brake cylinder support above the inside guides. The leading truck is of the usual swing bolster type, while the rear truck is of the "Devoy" design, built in accordance with drawings furnished by the railroad company. The truck boxes and

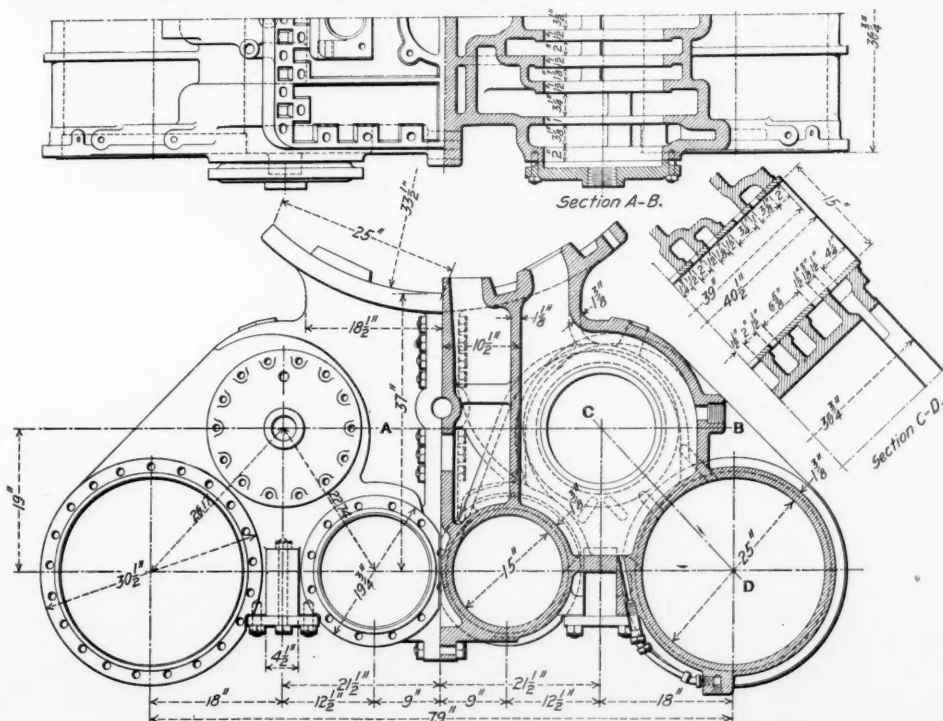
cross frame are of cast-steel in one piece, and the weight is transferred to the spring seats through roller bearings. The method of equalization is shown on the erecting card.

The boiler is of the wagon top type with butt jointed longitudinal seams having diamond welt strips inside. A notable feature is the ample depth of firebox, especially at the throat. The depth from the bottom of the mud ring to the under side of the barrel is 30 in., and to the center of the lowest row of tubes 34½ in. The mudring, which is of cast-steel and double riveted, is supported by sliding shoes in front and a buckle plate at the rear. Two rows of T irons support the front end of the crown sheet; otherwise the staying is radial. The brick arch is supported on four water tubes. The fire door opening is circular, 18 in. in diameter.

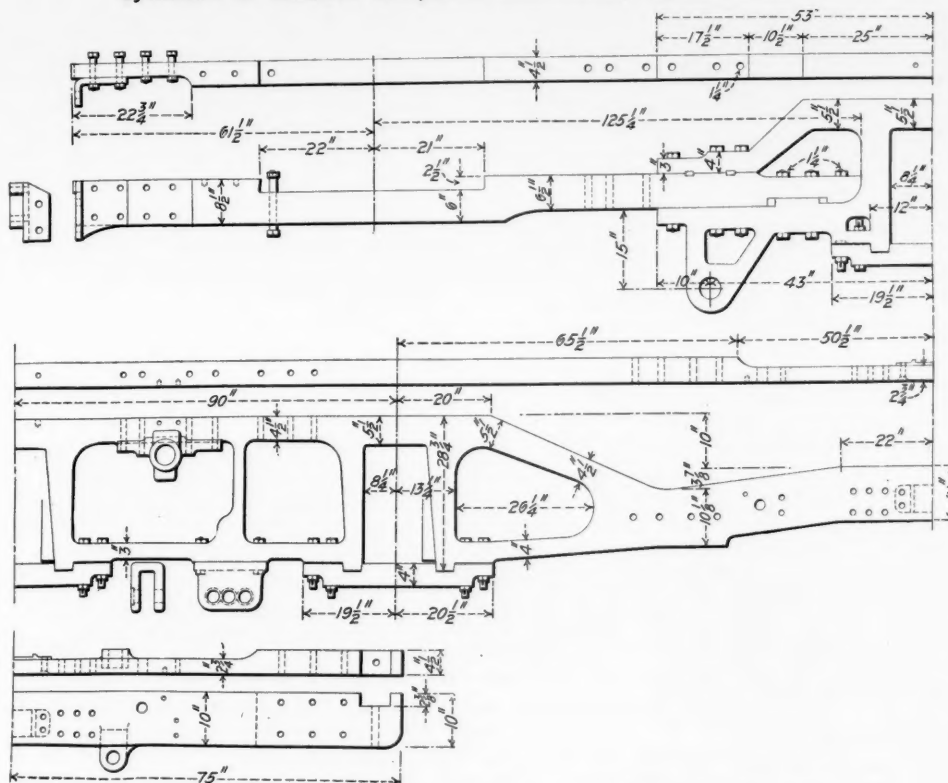
The construction of the tender calls for no special comment, beyond the fact that the frame is built of oak.

These are the first balanced compounds purchased by this road, although the line has had a large number of four-cylinder compound locomotives in service for some time. Opportunity should therefore be given for securing interesting comparative data relative to the performance of the new engines.

The following are some of the principal dimensions of these engines:



Cylinders of Baldwin Compound Locomotive; C., M. & St. P.



Frame of Atlantic Locomotive; Chicago, Milwaukee, & St. Paul.

Cylinders, diameter, h. p.	15 in.
Cylinders, diameter, l. p.	25 in.
Piston stroke	28 in.
Valves	Balanced piston
Boiler, diameter shell	66 in.
Boiler, thickness sheets	11/16 in. and 13/16 in.
Steam pressure	220 lbs.
Firebox, length	108 in.
" width	60 1/4 "
" depth, front	19 "
" depth, back	64 3/4 "
" thickness, sides	5/16 in.
" thickness back and crown	3/4 in.
" thickness tube sheets	1/2 in.
" water space, front	4 1/2 in.
" water space, sides and back	4 "
Tubes, number	268
" diameter	2 1/4 in.
" length	19 ft.
Heating surface firebox	155 sq. ft.
" tubes	3,015 "
" arch tubes	28 "
" total	3,198 "
Grate area	45.8 "
Wheels, diameter, driving	85 in.
" front truck	36 "
" back truck	49 "
" tender	38 "
Journals, main, driving	10 in. x 11 in.
" trailing, driving	9 " x 12 "
" front truck	6 " x 10 "
" back truck	8 1/2 " x 14 "
" tender	5 in. x 9 "
Wheel base, driving	7 ft. 6 in.
" engine	32 " 2 "
" engine and tender	63 " 1/2 "
Weight on drivers	107,550 lbs.
" front truck	52,000 "
" back truck	45,800 "
" total engine	205,350 "
" total engine and tender	340,000 "
Tank capacity, water	7,000 gals.
Tank capacity, coal	14 tons
Tractive effort	22,200 lbs.

Weight on drivers	= 4.84
Tractive effort	
Total weight	= 925.0
Tractive effort	
Tractive effort x diameter of drivers	= 590.0
Heating surface	
Heating surface	= 69.82
Grate area	
Firebox heating surface	= 5.72*
Total heating surface	
Total heating surface	= 33.63
Total weight	= 64.22
Total heating surface	
Volume of 2 h. p. cylinders, cu. ft.	= 5.72
Total heating surface	= 360.0 *
Volume 2 h. p. cylinders	
Grate area	= 8.00
Volume 2 h. p. cylinders	= 15.99
Volume of 2 l. p. cylinders	= 2.77
Volume of h.p. cylinders	
Tube heating surface equated to firebox heating surface (Vaughan formula), sq. ft.	691.51
Total equated firebox htg surf., sq. ft.	874.51
Total heating surface	= 3.66
Equated firebox heating surface	

*Per cent.

Americanizing Brazilian Railroads.*

As a result of concessions secured and purchases made within the past year American interests, including Canadian interests and supported largely by French capital, have secured more or less perfect control of a system of rail and water transportation forming a "belt line" about the whole of the better portion of Brazil and which, with Government railroad lines and Government subsidized steamships, reaches almost every portion of the immense republic. This great system is composed of parts which may be conveniently grouped under three heads, as the Sao Paulo-Rio Grande railroad lines; the Amazon-Bolivian system, and the Paraguayan-Bolivian connections.

The first of these subsidiary divisions will cover to a greater or less extent the southeastern portion of Brazil, reaching the coffee and live stock country and connecting them with the seaboard. The third will connect this coast system with the Paraguayan railroad, reaching eventually up into Bolivia, and by means of its own and Government lines, penetrating the great grazing country in the interior table-lands and valley country of south-central Brazil. The second system represents the connection of Bolivia with the Atlantic ocean by means of the Bolivian railroads and rivers, and the Madeira river, the Madeira-Mamore Railway, and the Amazon river.

The tangible outline of the first division is represented by the Sao Paulo-Rio Grande Railroad, the Sorocabana Railroad, and the port works at Rio Grande do Sul. The tangible outline of the second is represented by the concession for the Paraguayan railroad connections in relation to the line of the Brazilian Government into Matto Grosso and Goyaz, while that of the third division is represented by the port works at Para, the Madeira-Mamore Railroad, and the connections of the Bolivian railroads under contract held by what is known as the Speyer syndicate of New York.

About a year ago a concession was granted certain American-Canadian capitalists for the construction of docks and port works, and the removal of the sand bar which has concerned the port of Rio Grande do Sul and Port Allegre, on the Laguna dos Lagos. Within a very short time thereafter this same syndicate purchased the Sao Paulo & Rio Grande Railroad and proceeded to open up that portion of Brazil. A well-known American railroad builder and manager was brought down for the completion of the road, the enterprise was put upon the way to immediate completion, and the development of that portion of Brazil with American capital seemed about to commence. Within the past month this same syndicate leased the Sorocabana Railroad.

The work on the Sao Paulo railroad now represents the construction of the remaining parts of a railroad system which will reach from Rio de Janeiro to Sao Paulo over the Central Railroad of Brazil (Government owned and managed), and thence by the new lines to the extreme southern portion of Brazil. It will force the English monopoly between Sao Paulo and Santos to afford reasonable rates for Sao Paulo's products, to be collected largely by the new American system, or will afford an outlet to the seaboard for such products either over its own lines to the south or by a new line to be constructed direct to the seaboard.

The great country to the south of Sao Paulo—live stock, farming, timbering and mineral—will be opened up by affording it a route to the sea. That portion of Brazil which is susceptible to the most immediate and satisfactory development is reached by this American-Canadian railroad property.

The feeling shown by English residents and English investors in Brazil over the turn of events is not so much due to disappointment over the loss of any single particular investment as it is to the fact that the American-Canadian syndicate has undertaken development in Brazil upon so extensive a scale that its ultimate effects will be felt in every line of foreign business in Brazil. The actual work to be done by the syndicate in Sao Paulo and through the interior to Rio Grande do Sul, and thence in fact to Montevideo, is to be strictly up to date, representing the best there is in American railroading. It represents American materials and methods, American locomotives and American rolling stock. The port works at Rio Grande do Sul are indicative of the whole. There will be a double stone jetty extending over the bar, and within the port there will be a quay wall like that at Antwerp and the one at Hamburg. The railroads will come to the quay. There will be electric cranes, fireproof warehouses and the most modern equipment. The equipment of the railroads will be in keeping with the ports they are to serve.

Part of the work of this syndicate in connection with the Sao Paulo-Rio Grande Railroad is the construction of a line 600 miles into the interior of the country to Iguassu Falls, starting from the port of San Francisco. This line will open up Paraguay to the Atlantic by rail and will, by means of the Paraguayan railroads now existing and under concession, form connection with the new Bolivian railroads, for Bolivia is to be thoroughly developed in a railroad way and will have connections with the Atlantic ocean, both to the north by way of the Amazon and to the south through

Paraguay. There are interests in the United States now organizing for the further development of the Paraguayan and Bolivian connections. Independent of them, however, there are to be notable changes in Bolivia under the direction of the Speyer syndicate.

About three years ago there was signed in Petropolis, Brazil, a treaty between the Government of Brazil and that of Bolivia for the settlement of the boundary between the two countries—a boundary which had been the subject of dispute since the two Governments were founded. The chief dispute was over the large territory known as the "Acre," chiefly important for the amount of rubber it produces. In this treaty Bolivia quitclaimed its rights in the Acre for \$9,733,000. This money it has contracted with Speyer Brothers, of New York, to spend for over 300 miles of railroad to cost \$26,766,000, the balance of cost of the roads to be covered by bonds upon the railroads themselves. The connections with the southeast, which it is expected will be effected through the railroads mentioned as forming the second part of the system outlined, will probably be secondary to the principal system in Bolivia formed to connect with the great Amazon system, forming the third heading above indicated. This connection is to be effected by means of the Mamore river, the Madeira-Mamore Railroad and the Madeira and Amazon rivers.

In some respects the development of this great line of transportation is the most important of all those undertaken by the American-Canadian syndicate. The beginning of this line came in the granting of a concession about a year ago to the American syndicate to construct port works at Para (Belem), at the mouth of the Amazon river. Soon after the signing of the treaty of Petropolis the Brazilian Government, in line with the provisions of the treaty, granted a concession for the construction of a railroad from San Antonio, on the Madeira river, to a point on the Mamore river above the falls, which have made navigation by that river impossible.

The concession was granted to a Brazilian as against an American syndicate, which bid for it, and it was understood that French capital was secured to work it as a Brazilian concern. The announcement was made a short time since, however, that the American-Canadian syndicate constructing the Para port works and operating in other portions of Brazil had bought the concession and had men on the way to begin work under it. A party of 30 men, under the charge of H. C. Miller, at one time chief assistant in a Nicaraguan canal survey, are now engaged in the preliminary work, and men and materials for the construction of the road are now on the way, the plans calling for the construction of warehouses, workmen's cottages and even a cold-storage plant.

Commencing with the railroad development of Bolivia and with fully 3,000 miles of navigable rivers to feed the new railroad between the Madeira and Mamore rivers, the line of traffic from La Paz, the capital of Bolivia, to the Atlantic, with the exception of the rivers and the river traffic, which will always be more or less under the control of the Brazilian Government, will be American in control and methods. The principal product of that country at the present time is rubber, but what the limits are of the country's production in other lines no one can tell. The Bolivian country opened up by the new railroad system and connected with the sea, as well as the Brazilian territory reached in the lines west from the southern ports of Brazil, is one of the finest in the world for live-stock raising and for general agriculture. In a climate both temperate and healthful, free from malarial and similar diseases, with a soil more fertile and less subject to deterioration than that of almost any other portion of Brazil, there is apparently no limit to possible development.

EFFECT ON BOLIVIA.

It is important as well as interesting to note the possible effect of this development upon Bolivia. A correspondent of the *Financial News*, who is evidently acquainted with conditions in Bolivia, says of the matter:

It is, however, interesting to consider the effect on a country hitherto so isolated as Bolivia of the expenditure of so large a sum of money as £5,500,000 on development in any form. Among other things, increased means of transportation and locomotion will induce a great deal of traveling in the country. There will be an enormous influx of foreigners to Bolivia. These people will secure the major portion of the better-paying industries, and most of the Bolivians will accept minor posts, for out of a population of 1,750,000 there are 1,500,000 Indians, speaking only native dialects. There will be a great expansion in most branches of trade and industry. Banking will increase and there will be a great accession of wealth, most of which will be secured by the new arrivals. Stronger characters will bear down the passive and inexperienced Bolivians. The mining industry, already encouraged by high prices in Bolivia's special products, is likely to progress in an astonishing degree, and all existing commercial mechanism will be strained to keep pace with expanding trade. How much attention from neighboring nations this will attract can be understood, and, in one way and another, Bolivia's awakening will be watched with interest by many persons.

The amount of money invested and to be invested immediately in the several enterprises, including the Bolivian development, will probably exceed \$150,000,000. The movement of American railroad and other material in this direction for such works represents the most active and the most considerable element in the export trade of the United States to Brazil and Bolivia.

*Consular report.

GENERAL NEWS SECTION

NOTES.

The Grand Trunk expects to begin operating a car ferry between Grand Haven and Milwaukee next week. The terminal in Milwaukee is practically completed.

Beginning December 8, the Southern Pacific will run two passenger trains daily each way between Houston, Tex., and the Pacific coast, instead of one a day, as at present.

The Huntingdon & Broad Top, after a strike lasting two weeks, has granted the demand of its trainmen that they be paid at the rates prevailing on the Pennsylvania Railroad.

At St. Louis the Wabash Railroad has been fined \$200 for failing to promptly report train accidents, as required by the Interstate Commerce Commission, under the Act of 1901.

The Baltimore & Ohio, which is using coke on some of its locomotives in the residential part of Pittsburgh, intends to fit a considerable additional number of engines for burning that fuel.

The Official (Freight) Classification Committee has announced that henceforth no changes will be made in the classification of commodities in freight tariffs until after the proposed changes have been published 30 days.

J. N. Seale, Manager of the Northern and Eastern districts of the Southern, had a stroke of paralysis last Saturday while at Salisbury, N. C. He was taken to Washington, where his condition is said to have improved.

The Atlanta & West Point reports an increase of 18 per cent. in passenger receipts for the month of September over the corresponding month of last year. On this road the state rate, now in force, is 2 cents a mile.

In Macon, Ga., Wilmington, N. C., and other cities business men have combined to request the governors to be less severe in their demands on the railroads, declaring that their radical action has disturbed business seriously and that at the present time it is highly important to allay unfavorable criticism on the railroads.

The Pennsylvania has issued an order to its agents that freight must be kept moving on Sundays to avoid a congestion of loaded cars at the terminals, and to meet the largely increased demands of freight traffic at this time. For several years the movement of much of the low-class freight has been practically suspended on Sunday.

The people of Middletown, N. Y., are complaining because the Erie Railroad has covered "nearly every available space" on the outside of its handsome station in that city, with billboards. It is reported that the Erie intends to do a general advertising business. Billboards have been put up at Erie stations all the way from Jersey City to Middletown.

The State Railroad Commission of Georgia, acting on a report of an inspector and on personal inspections by two of the commissioners, has ordered the Georgia Railroad, within 30 days, to replace defective ties and within 10 days to replace defective spikes, bolts and angle plates at certain specified places. According to the newspapers the defects found were numerous.

In the Federal Court at Little Rock, Ark., November 9, the Arkansas Railroad Commission was temporarily enjoined from carrying into effect its recent order instructing the Prosecuting Attorney to institute suit against the Iron Mountain to collect penalties aggregating \$990,000 for alleged discrimination in furnishing coal operators with cars in the Spadra and Denning coal fields.

The Supreme Court of the United States has affirmed the validity of the South Carolina law providing for a fine of \$50 upon a railroad for failing within 40 days to settle claims for damage to freight carried between points within the state. The court held that the act applied only to intrastate traffic, and as the State Supreme Court held it was valid there was no Federal question involved.

The Chicago, Rock Island & Pacific is now among the roads which publishes "merits" credited to employees for doing more than their duty. Some of the credits appear to have been made with a liberal hand, as for example, one to a man who was very prompt in responding to a call for the wrecking car. A passenger brakeman in Oklahoma received 10 merits because, while his train was delayed a long time by a washout, he borrowed a broom and swept and dusted the coaches.

The Wabash has notified its competitors that it may decide to give store-door freight service, or its equivalent, in St. Louis because of the disadvantage which it suffers by the absorption of

cartage charges to and from East St. Louis by the other roads. It appears that these charges are such that from parts of St. Louis it is cheaper for shippers to send freight across the river than to send it to the Wabash freight house.

The Southern Kansas Railway, a line of 129 miles in the western part of Texas, operated by the Atchison, Topeka & Santa Fe, owns no cars or engines of any kind; and Mr. Colquitt, member of the State Railroad Commission, has formally moved that the Commission order the company to at once buy five passenger and 12 freight engines, 12 passenger cars, four express and mail cars, 500 cattle cars and 200 box cars; all for use in Texas.

The Boston & Albany, already burdened with the autumn rush of freight, has issued appeals through the advertising columns of the newspapers of the principal cities, calling on consignees to promptly unload bulk freight. At Worcester on a given day last week the number of bulk cars waiting to be unloaded was 352, while the number waiting on side tracks to be brought into the city was 912. Springfield and Pittsfield were in a similar condition.

At the shops of the American Locomotive Company at Dunkirk, N. Y., the working day has been reduced from 10 hours to nine, and the shops will be closed Saturday afternoons. The New York Central has canceled a part of its last large order for locomotives. The New York Air Brake Co., Watertown, N. Y., has reduced the pay of officers and employees 10 per cent. The Illinois Central has reduced the working time of its shops at Burnside, Ill., from 10 to nine hours a day.

On the Boston & Maine, passenger tickets which are sold at reduced rates to compete with electric lines are made good only for continuous passage and no baggage is checked on them. This no-baggage arrangement has been in force over three years and appears to be entirely satisfactory. Between Springfield and Greenfield, Mass., where the regular rate is 73 cents, the conditional ticket is sold at 50 cents. Similar tickets, with a less marked difference in rates, are sold between Portland, Me., and Kennebunk.

The Southern Pacific reports that from \$3,528,199 in 1902, the cost of locomotive repairs increased to \$5,717,667 in 1907. The average of \$2,666 per locomotive in 1902 rose to \$3,381 in 1907. From 1902 to 1907 the average cost of repairs per passenger car increased from \$741 to \$801 for this year. Repairs of freight cars increased in cost from \$2,380,410 in 1902 to \$3,875,956 in 1907. The value of freight cars withdrawn from service, largely because too small and weak to be run in trains with large cars, averaged \$732, 128 for each of the six years covered by the figures.

The Southern Pacific, which for the past six years, has been occupying the Illinois Central passenger station at New Orleans, bringing its passenger trains across from the other side of the Mississippi on ferry boats, has abandoned that station, at least temporarily, and all passengers will leave and take the cars at Algiers, being carried across the river on ferry boats to and from the Southern Pacific station at the foot of Esplanade street, New Orleans. This change has been made necessary by the caving in of a bank. The new place of landing in New Orleans is close to the station of the Louisville & Nashville.

At a hearing in Albany on a complaint of a brotherhood representative that insufficient men were employed on trains, it was testified that the Erie Railroad now has its colored porters on passenger trains qualified for flagging duty. The brotherhood representative said that he could not get trainmen to appear and testify because they feared dismissal, whereupon Vice-President Place, of the New York Central, announced that no employee of that company would be discharged for testifying. The commission will send an inspector over the Pennsylvania division of the New York Central to examine the ground for the complaint concerning that line.

Judge Calhoun, of Texas, has sustained the validity of the full crew law of that state, prescribing the number of men to be assigned to trains, and assessed a fine of \$2,000 and costs against the Missouri, Kansas & Texas for violating it. The case will be appealed. The Pennsylvania and other companies are named as defendants in a suit to test the constitutionality of the "full crew law" passed by the last Legislature of Indiana. The railroads and the railroad commission have submitted an agreed statement of facts. A press despatch says that most of the roads are obeying the law on trains carrying intrastate freight exclusively, but on interstate trains are employing the same number of men as before the law was passed.

It appears that the Merchants' Despatch Transportation Co. has not been dissolved, nor has it abandoned all of its business. As before reported, the fast freight line business will now be done by the railroads, but the Merchants' Despatch will continue to exist as

a car-owner, and it retains its car shops at Despatch, N. Y. The ice houses at East Buffalo and Karner have been sold to the New York Central; the ice house at West Seneca, N. Y., has been sold to the Lake Shore & Michigan Southern, and that at Detroit to the Michigan Central. The several thousand M. D. T. box cars have been sold to the New York Central and the Lake Shore, as have the carriage cars owned by the company; but the 5,284 refrigerator cars are retained. Thus, the box cars will hereafter be paid for by borrowing roads at the per diem rate, while the refrigerators will continue to be paid for by the mile.

Chicago railroads now report that miscellaneous freight business has slacked sufficiently to enable them to accept all shipments offered. At Pittsburgh, however, reports continue to indicate a shortage of cars, and many industrial establishments are said to be suffering loss by delays. A despatch from that city, November 10, says that orders for 500,000 tons of coal for points in the Northwest have been refused because it was impossible to secure coal cars before the close of navigation. An officer of the Burlington road says that that company now has 1,400 box, coal and cattle cars standing idle. The state railroad commissioners of Montana have approved an order of the Northern Pacific suspending the operation of six passenger trains for 90 days in order to enable the road to relieve the congestion of freight; this notwithstanding loud complaints from citizens of the towns on the branches where the trains are to be taken off.

Twenty-two railroads, most of them prominent companies, have invited all the other roads to attend a meeting in Chicago next week, Wednesday, to see if they can agree to adopt a penalty of \$5 for wrongful diversion of cars in switching territory. The proposed rules are similar to those which were proposed in connection with the rule for a general diversion penalty (which failed of adoption) except that they apply only to movements in switching territory. The 22 roads have agreed with each other, already, to abide by the proposed rules for six months, on the understanding that they shall not be changed in next Wednesday's meeting, except in accordance with the rules of procedure, which are followed at the meetings of the American Railway Association. The 22 roads are: Chicago, Burlington & Quincy; Chicago, Rock Island & Pacific; Illinois Central; Pennsylvania Lines West; Chicago & North-Western; Atchison, Topeka & Santa Fe; Baltimore & Ohio; St. Louis & San Francisco; Belt Line Railroad of Chicago; Quincy, Omaha & Kansas City; Chesapeake & Ohio; Buffalo & Susquehanna; New York, Chicago & St. Louis; Detroit, Toledo & Ironton; Ann Arbor Railroad; Norfolk & Western; Erie Railroad; Louisville & Nashville; Hocking Valley; Lehigh Valley; Mobile & Ohio, and Louisville, Henderson & St. Louis.

The state railroad commissioners of Massachusetts, reporting on the records sent in by the railroads showing delays for passenger train say that:

"The record of train delays upon the Boston & Albany Railroad for the three weeks ended October 19 is so bad that there is no occasion to analyze it. The service as a whole has been growing worse rather than better during the last eight months, as must have been the case with locomotives overtaxed and tracks overloaded.

"It has become evident that the expenditures authorized were on too frugal a scale, and that the work of improvement was tardily begun and ineffectively prosecuted; in brief, that there has been a failure to meet the emergency which the situation presented.

"Discouraging as this conclusion is and destructive as it must be of faith in assurances, the vital question is whether the outlook to-day is any better than it was six weeks ago. That question, in our opinion, ought to be answered in the affirmative. No impartial critic in possession of all the facts can fail to note the signs of a thorough understanding, at least of the troubles which have caused disaster, and of a new administrative purpose to drop superficial treatment of symptoms and to get at the real disease.

"* * * A part of the criticism which has been so lavishly expended upon the Boston & Albany might well be diverted to the record of trains upon other railroads, where, in varying degrees, there have also been delays. * * *

Reciprocal Demurrage in Texas.

At a conference between the principal railroads and a large number of representatives of shippers, an agreement has been reached for the establishment on the railroads of Texas of "reciprocal demurrage," and it is expected that the Railroad Commission will adopt and promulgate the rules which have been formulated. The conference recommends that a railroad shall have five days in which to fill orders for not over five cars and an additional day for each car. Demurrage is to be \$1 a day as now; and the penalty for failure to furnish cars 50 cents a day. The same penalty applies for failure to move cars at least 25 miles a day. The railroads agree that the shippers shall be represented on the Texas Car Service (Demurrage) Association.

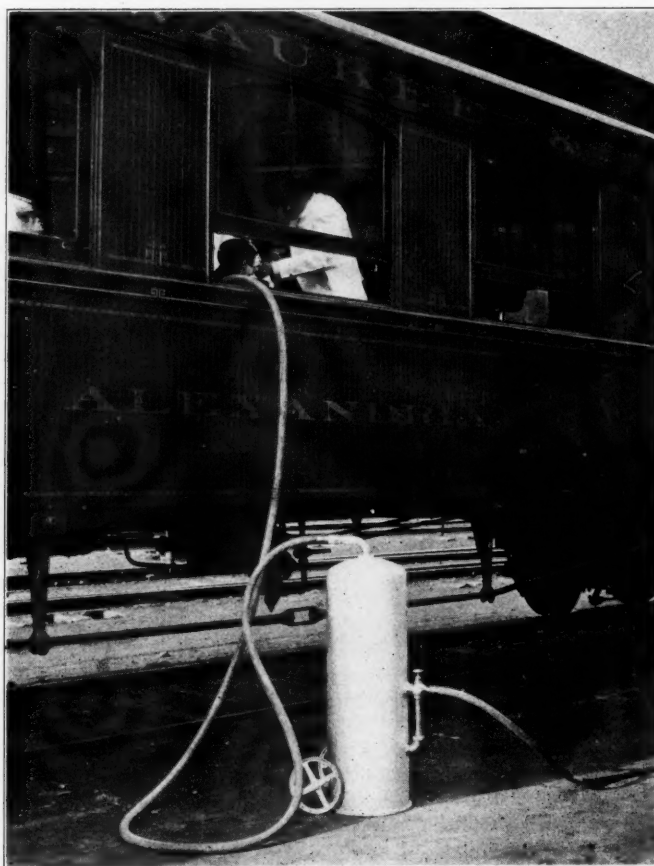
The "Aero" Vacuum System for Cleaning Cars.

The Chicago, Milwaukee & St. Paul has installed in its Western avenue yards, Chicago, the "Aero" vacuum system for cleaning cars. This system, which has been in use for some time for house cleaning and similar purposes, has lately been adapted to car cleaning, the installation on the C. M. & St. P. being the first. The plant is portable and the mechanism simple. There are no vacuum pumps and elaborate piping system. Instead there is a dust separator tank on wheels, the mechanism for producing the vacuum, which is affixed to the side of the tank, and the necessary hose and nozzles.

A jet of compressed air blowing through a special designed aspirator produces a vacuum of about 10 in. The compressed air is taken from the yard pipes, and if an air cock is not convenient to the car to be cleaned the aspirator can be connected to the air line of a string of cars standing on the cleaning tracks and the air cock reached in that way.

The dust-laden air is drawn from the car into the separator tank, where the dust is removed from the air partly by centrifugal force and partly by a special strainer. The exhaust air is discharged at the bottom of the tank. The dust is removed from the tank through a door at the bottom.

The novel feature of the system is the dust separator, which it



Cleaning Parlor Car by "Aero" Vacuum Machine.

is claimed is quite efficient, separating all entrained dust from the air. Each outfit has several nozzles of different shapes for the different kinds of work. A tool with an opening 10 in. wide is used for carpets, curtains and bedding. For the seats a 4-in. upholstery nozzle is used, and for the arm-rests and other surfaces there is a special curved nozzle.

The C. M. & St. P. adopted the system after a series of tests lasting for months. These tests brought out several interesting facts. Cars cleaned by the system have the dust so completely removed that a thorough cleaning is necessary only every third or fourth trip. On intermediate trips a simple brushing is sufficient. This keeps a cushion in better shape than when cleaned every trip by the beating or blowing method. The vacuum system saves so much time and labor that three men have been dispensed with at a saving of \$150 a month. Other tests to compare the vacuum with the blowing method showed that after sleeping cars had been thoroughly blown by compressed air and were ready for the station, the vacuum apparatus would remove 1 to 2½ lbs. of dust from the seats and carpets.

There are two machines in use in the Western avenue yard of the St. Paul, and at present they take care of 12 to 15 sleeping cars a day and an equal number of coaches. A cleaning outfit complete costs \$350. The American Air Cleaning Co., Milwaukee, Wis., is the maker.

Atchison Fined \$330,000.

In the United States District Court at Los Angeles, Nov. 7, Judge Olin Wellborn fined the Atchison, Topeka & Santa Fe \$330,000 for paying rebates illegally. The company was convicted on October 11 last by a jury in the Federal court of granting rebates to the Grand Canyon Lime & Cement Company, of Arizona. It was found guilty on all the 66 counts. The rebates were given on shipments of lime and cement from Nelson, Ariz., to Los Angeles. The company claimed that these amounts were allowances for damages to goods which were allowed after such claims had been regularly presented and proved in each instance. Judge Wellborn says: "I am inclined to think that the defendant's underlying purpose in the transaction complained of was to foster on its own lines any industry which would permanently contribute to its traffic against competitors in other localities. But the evidence shows that the concessions were intentionally and systematically made, and it is hard to believe that the defendant did not know that they were unlawful departures from its established tariff. At all events, ignorance of the law under the circumstances in this case would imply a degree of negligence well nigh equivalent to guilty knowledge. The judgment of the court is that the defendant be sentenced to pay a fine of \$5,000 on each count of the indictments."

Judge Wellborn allowed a stay of 30 days, with the privilege of an extension. Judge Wellborn is 64 years old, a native of Georgia and a Confederate veteran. He went to California in 1887, and was appointed to the Federal bench by President Cleveland in 1895. He served in Congress from the Dallas (Tex.) district in the 46th, 47th, 48th and 49th Congresses.

An officer of the Atchison, Topeka & Santa Fe in New York said: "This entire case is an outrage and the matter will certainly be appealed. A man in a remote section of Arizona asked us to name a rate on lime shipments to Los Angeles. We stipulated that the minimum carload should consist of 40,000 lbs. The place was so small that there were no track scales there. The shipper at times did not send the minimum load, and many of his carloads on arrival at Los Angeles showed only 35,000 lbs. The man said he could not help having sent an insufficient amount, owing to the absence of track scales, and asked that in such instances he be charged only for the amount sent."

"The adjustment of his claim did not even reach the officials of the company. It came under the eye of a clerk, to whom the claim seemed so just that he granted it without even presenting the matter to his superiors, who were unaware of it." * * *

Rochester-Coburg Car Ferry.

The Buffalo, Rochester & Pittsburgh and the Grand Trunk have established a car ferry across Lake Ontario between Rochester, N. Y., and Coburg, Ont. A steamer with capacity for 26 cars has been put in service and it is expected to be powerful enough to cut its way through the heaviest ice. Its ordinary speed is 15 knots an hour. The B. R. & P. has built a dock on the Genesee river, which is reached by its Charlotte branch. It is expected that the ferry will secure a good traffic in coal from the Pittsburgh district to points in Canada. The boat was built by the Canadian Shipbuilding Company. It is the largest ever used on Lake Ontario, being 316 ft. long, 57 ft. 7 in. beam and 17 ft. draft. While especially designed for carrying freight, accommodations in keeping with the best modern sea going vessels have been provided on the upper decks for passengers, comprising 32 staterooms, dining saloons and lounging rooms. The distance between Rochester and Coburg is 60 miles, and it is expected that the boat will make two round trips each 24 hours.

Alabama Legislature.

The special session of the Alabama legislature opened November 7. Gov. Comer in his message declared that the control and regulation of the railroads by the state is a question more important than the making of rates or any other matter, in that it involves the question of the right of the state to control its internal affairs. He says that President Smith, of the Louisville & Nashville, has held out against the Alabama laws, while others have put them into effect; has defied the state and its people by conducting a lobby at the Capitol, openly admitting that his company influenced legislation in the past; has called the Governors of Alabama and Georgia Populistic; has raised rates overnight in defiance of state laws, and has generally refused to recognize the right of the state to make laws applying to transportation companies. That the Alabama rate laws are not confiscatory is evidenced, the Governor says, by the fact that they prevail in other nearby states, and provide profit. Financial troubles, he says, are due to the rascality of the high financiers, and the producer of the cotton of the South is now coming to save the country from panic. The Louisville & Nashville is charged with manipulation to prevent use of waterways, to make

rules for handling coal and as to demurrage and freight rates, which are arbitrary.

President Smith has issued a pamphlet replying to Governor Comer's charges.

Eight bills have been introduced in the legislature to carry out the Governor's proposals, and some of the bills under consideration in the house were passed by that body on Tuesday of this week. The maximum rate bill, which was enjoined by the railroads, was repealed; the authority given the railroad commissioners to bring suit was revoked with a view to preventing the railroads from enjoining the state. The bill providing for penalties for failing to put in effect the state laws was passed. The passage of these bills and of the eight bills known as "the 110 commodity rate bills" is expected to put the low rates into effect without going to court. Each of the bills provides a heavy penalty. There is another bill, providing that a passenger who tenders the amount required by state law for passage and is ejected from a train may bring suit within ten years. The bills are carefully drawn by the most prominent constitutional lawyers in the state.

New York State Commission Orders.

The Public Service Commission of New York, Second district, has ordered the railroads of the state to report all important improvements to roadway, buildings, bridges and terminals and all additions to rolling stock, made during the year ended June 30 last, and also improvements of this kind now unfinished. The Commission calls on the roads for full and prompt responses, believing that by furnishing the desired information, to be laid by the Commission before the Legislature, the roads will be promoting their own interests and disarming prejudice.

The Commission has also ordered the railroads of the state to have their local agents report, direct to the Commission, all cases in which it is impossible to provide cars for shippers within four days of the time the cars are required.

The Commission has also ordered all railroads to promptly report to the Commission, with full particulars, any embargo which may be laid on intrastate traffic; also to send notice when any embargo is revoked or modified.

Cement Show in Chicago.

The first annual cement show will be held in Chicago at the Coliseum, December 17 to 21 inclusive. It will be under the auspices of the Cement Products Exhibition Co., which was formed to hold annual expositions of cement products. The enterprise is being promoted by Portland cement manufacturing interests of the Middle West. Its scope may be judged from the classifications of exhibits, which include: Cement, concrete mixers, block machines, brick machines, cement pipe machines, cement tile machines, cement post machines, cement coloring mixtures, reinforcing metal, cement publications, testing machinery, sheet piling, aggregates, sand and technical institutions. L. L. Fest, who has been manager of several large trade exhibitions of this kind, is in charge. It is hoped that the attendance will be increased by the fact that the date set will allow visitors to do their Christmas shopping in Chicago. It is desired that everybody directly or indirectly interested in the cement industry will do something to contribute to the success of this demonstration, which is intended to exploit cement as the leading building material of the future.

A State Rule for Distributing Coal Cars.

The State Railroad Commission of Indiana has given to the Southern Indiana Railroad an order directing in detail how that railroad shall distribute cars to the coal mines dependent upon it for transportation, leaving no discretion to the management of the road. The order is the result of an investigation of charges by the Calora Coal Company that the Southern Indiana was grossly discriminating against it and in favor of the mines owned wholly or in part by John R. Walsh, who controls the road. The commission directs that the distribution of cars shall be based on the average daily capacity, or on the daily requirements, of each mine. If the daily requirement of a mine is 100 cars and there are only 500 cars to be distributed, the mine will receive one-fifth of the cars available. The mine, however, has the right to increase its daily requirements up to its average daily capacity, but not beyond this point.

Each mine must furnish by telephone daily, between 5 and 6 p.m., all information necessary to enable the company to make a distribution of cars in accordance with the rules of the commission. The road must include in the "total equipment" on its line "available for the operation of all mines" all "system" coal cars that day apportioned to the mining district; all foreign cars available for use in the district; all foreign cars specially assigned to or requested by particular mines for loading with commercial coal;

all foreign cars specially consigned for loading with fuel coal for foreign lines, and all private cars owned by mines on the line of the Southern Indiana.

On any day when the allotment of cars due the mines which furnish the Southern Indiana with fuel coal [for its locomotives] does not equal the requirements of the railroad, such mines shall be served first despite the lack of cars in the general distribution.

The commission requires the road to arbitrarily assign from its equipment before distribution a reasonable number of cars for the development of new mines. This shall be continued until the capacity of the new mine is equal to the lowest capacity of any mine operating on the road.

TRADE CATALOGUES.

Welded Pipe.—The National Tube Company, Pittsburgh, Pa., has published an exceptionally well illustrated pamphlet entitled "The Manufacture of Modern Welded Pipe." It describes the older process of making wrought-iron pipes, taking up each step beginning with the ore, and then goes on to tell the history of pipe steel and the stages in the making of steel pipe nowadays at the company's works. The last part of the pamphlet is taken up with a comparison of the relative value of steel and iron pipe.

Friction Draft Gear.—The Republic Railway Appliance Co., St. Louis, Mo., has a new catalogue of its "Republic" friction draft gear. It is a 6-in. x 9-in. pamphlet presenting in concise form essential information concerning the device. The construction of the gear, the parts in detail and their relation are shown by half-tone engravings and the different applications by line engravings. The action of the gear and its advantages are briefly given in the text.

MANUFACTURING AND BUSINESS.

The Schoen Steel Wheel Co., Pittsburgh, Pa., has opened an office at 1407 Fisher building, Chicago, with J. T. Milner as Western Sales Agent.

The jury of awards for the Jamestown Exposition has awarded the Baldwin Locomotive Works, Philadelphia, Pa., a diploma of a gold medal for installation of exhibit.

During October of this year, the American Car & Foundry Company, New York, built 10,780 cars and repaired 626 cars. Its output of cars during the quarter ended October 31, 1907, was greater than in any previous quarter.

S. T. Callaway has been elected Secretary of the American Locomotive Company, New York, succeeding Leigh Best, who has been Secretary of the company since its organization. Mr. Best remains Vice-President. Other officers were re-elected, as follows: President, W. H. Marshall; Vice-President, R. J. Gross; Vice-President, H. F. Ball; Vice-President, David Van Alstyne; Treasurer, C. B. Denny; Comptroller, C. E. Patterson.

Contracts for erecting buildings and for other structural work at the \$1,000,000 open hearth steel plant and finishing mills at McKees Rocks, Pa., of the Schoen Steel Wheel Co., Pittsburgh, Pa., have been let to the Riter-Conley Manufacturing Co., Pittsburgh, Pa. The Shaw Electric Crane Co., Muskegon, Mich., has the contract for a number of heavy cranes, and the Porter-Miller Co. will install a large gas producer. It is expected that the plant will be in operation next spring.

The Westinghouse air-brake equipment specified for the six switching locomotives, which, as mentioned in another column, are to be built by the Davenport Locomotive Works, Davenport, Iowa, for John Marsch, Cleveland, Ohio, consists of Westinghouse automatic and straight air-brakes with two 9½-in. pumps and triple train lines for operating brakes and pneumatic dump cars. These are equipped with two-way cocks so that all pneumatic operations are handled from the cab.

Richard D. Hurley, Manager of the Pittsburgh office of the Independent Pneumatic Tool Company, Chicago, died at Chicago on November 5 of heart trouble, which did not develop until about a month ago. Mr. Hurley was 39 years old and had been in the pneumatic tool business for 10 years. He was a brother of John D. Hurley, Vice-President and General Manager of the Independent Pneumatic Tool Company, and of Edward N. Hurley, formerly President of the Standard Pneumatic Tool Company.

The United States Steel Corporation is exchanging its 5 per cent. sinking fund bonds for Tennessee Coal, Iron & Railroad stock at the rate of \$120 face value in bonds for each share of stock. At the end of last week, \$21,500,000 of the about \$33,000,000 outstanding T. C. I. & R. R. stock had been exchanged and it was expected that nearly all the rest would be turned in on the same basis. G. C. Crawford, of the National Tube Co., Pittsburgh, Pa., has been elected President of the T. C. I. & R. R., succeeding J. A. Topping.

A cash dividend of 3 per cent. and a scrip dividend of 20 per cent. on the \$17,240,000 outstanding 6 per cent. cumulative preferred stock of the American Steel Foundries, New York, has been recommended by the Board of Directors. The cash dividend will be a semi-annual dividend and the scrip, which is to bear interest at 4 per cent., represents back dividends, nothing having been paid since the 2½ per cent. in 1904. A stockholders' meeting is to be held soon. The above dividends are to be paid only on condition that preferred stockholders exchange their stock for an issue of new preferred stock which will not be cumulative.

The General Electric Company, Schenectady, N. Y., has been awarded two gold medals and a bronze medal for its exhibit at the Jamestown Exposition. The company's exhibits are grouped in three departments: machinery, manufactures and liberal arts, and mining. In the first classification, a gold medal was awarded for a collection of motors applied to various machine tools and other devices. In the second department, a gold medal was given for an exhibit of arc and incandescent lamps and electric cooking applications. The bronze medal was awarded for a special motor designed particularly for use with an Ingersoll-Temple pneumatic rock drill. The company was also awarded a silver medal for installation of exhibit.

The Buffalo Brake Beam Co., New York City, is now occupying its new plant at West Seneca, Buffalo, N. Y. The plant covers five acres. The buildings consist of the main shop, 60 ft. x 200 ft., with an adjoining open shed extension 100 ft. x 24 ft.; they are equipped with modern machinery and have twice the capacity of the old plant, which was recently destroyed by fire. The fire occurring, as it did, when the new plant was nearly ready for occupancy, the company was hampered very slightly in making deliveries. A siding from the South Buffalo Railway runs into the yard of the new plant, with a track on each side of the main building on a 1 per cent. grade, so that when empty or loaded cars are switched on to these tracks they return to the main line by gravity, thus saving time and expense in switching.

Iron and Steel.

The Bessemer & Lake Erie has ordered 183,000 steel ties.

The Harriman Lines are in the market for 30,000 tons of rails.

OBITUARY NOTICES.

Frank H. Earle, President of the Raritan River Railroad, died of heart disease on November 7 at his home in Newark, N. J. Mr. Earle was 65 years old.

Charles E. Perkins, formerly and for many years President of the Chicago, Burlington & Quincy, died on November 8 at his home at Westwood, Mass.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, etc., see advertising page 24.)

New England Railroad Club.

At the meeting of this club in Boston, November 12, a paper on the "Trials of a Master Mechanic," by R. H. Rogers, was discussed.

Canadian Society of Civil Engineers.

At a meeting of the Mechanical Section, Thursday, November 14, a paper on "Hydraulic Turbines," by W. Kennedy, Jr., was read by the author.

Western Railway Club.

At the November meeting, which will be held Tuesday, the 19th inst., at 8 p.m., in the Auditorium Hotel, Chicago, a paper entitled "The Influence of Heat Value and Distribution on Railway Fuel Cost" will be presented by J. G. Crawford, Fuel Engineer of the C., B. & Q. Ry.

Car Accountants.

The winter meeting of the Association of Transportation and Car Accounting Officers will be held at the Auditorium Hotel, Chicago, December 10 and 11. There will be reports from the Committees on Car Service and Per Diem, on Office Methods and Accounting, on Railroad Business Mail, on Conducting Freight Transportation, and on Conducting Passenger Transportation.

New York Railroad Club.

At the meeting of this club, November 15, a paper on the "Brass Foundry; Modern Method of Melting and Handling Metal," by W. S. Quigley, will be presented for discussion.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Astoria & Columbia River.—The office of M. P. Martin, Secretary and Treasurer, has been moved from Tacoma, Wash., to Portland, Ore.

Central of Georgia.—William Nelson Cromwell and J. W. Castles have been elected Directors, succeeding Oakleigh Thorne and Marsden J. Perry, resigned.

The title of W. D. Beymer has been changed from Auditor to Comptroller. His office is at Savannah, Ga.

Chicago & Alton.—The accounting departments of this company and of the Toledo, St. Louis & Western are to be combined, effective December 1. W. D. Tucker, General Auditor of the Toledo, St. Louis & Western, has been appointed General Auditor of both companies, with office at Chicago.

Chicago & Eastern Illinois.—H. J. Cronin, Auditor of Disbursements of the St. Louis & San Francisco, has been appointed Assistant Auditor of the Chicago & Eastern Illinois, with office at Chicago, succeeding John J. Duck.

Chicago, Ziegler & Gulf.—W. B. Clark, Traffic Manager, has been appointed also Auditor, succeeding I. F. Neitz.

Lehigh Valley.—E. A. Albright, Assistant to the President, has been appointed Assistant Secretary, succeeding L. D. Smith, who has succeeded Mr. Albright in his former position.

Louisville & Atlantic.—A. E. Richards, Vice-President and General Counsel, has been elected President, with office at Louisville, Ky. E. M. Wallace, Secretary, has been appointed also General Counsel.

St. Louis & San Francisco.—See Chicago & Eastern Illinois.

Tehuantepec National.—H. O'Connor, Auditor, has resigned.

Toledo, St. Louis & Western.—See Chicago & Alton.

Wabash.—James L. Minnis, General Attorney, has been appointed General Solicitor, with office at St. Louis, Mo., succeeding C. N. Travous, deceased.

Operating Officers.

Alabama Great Southern.—R. E. Boswell, Superintendent, has resigned to go to the Seaboard Air Line.

Beaumont, Sour Lake & Western.—H. Hall, trainmaster of the St. Louis & San Francisco at Chaffee, Mo., has been appointed Superintendent, with office at Beaumont, Tex.

Central Vermont.—W. E. Costello, formerly Superintendent of the Union Pacific at Salt Lake City, Utah, has been appointed Superintendent of the Southern division of the Central Vermont, with office at New London, Conn., succeeding E. D. Nash, resigned to go to another company.

Chicago, Rock Island & Gulf.—H. E. Allen has been appointed Superintendent at Amarillo, Tex.

Chicago, Rock Island & Pacific.—Ariel B. Copley, who was recently appointed Superintendent of the Indian Territory division, is 43 years old, and all his railroad work has been done on the Rock Island. He began in 1881 as a messenger boy. From 1886 to 1893 he was a trainman on the Iowa division, and was then made assistant yardmaster at Des Moines, Iowa. In 1901 he was made general yardmaster of the Des Moines and Valley Junction yards, and two years later was made Trainmaster of the Dakota division. In 1904 he was transferred to the East Iowa division and the next year to the Illinois division. At the end of 1906 he was made Trainmaster of the Colorado division and last spring was appointed Superintendent of the Kansas City terminal division, where he remained until his recent promotion.

Detroit, Toledo & Ironton.—J. M. Jones, chief despatcher at Springfield, Ohio, has been appointed Trainmaster at Napoleon, Ohio, succeeding D. J. Hardy, resigned.

Gila Valley, Globe & Northern.—L. H. Landis has been appointed General Agent at Globe, Ariz.

Gulf Line Railway.—D. L. Turner, Jr., is Superintendent, with office at Sylvester, Ga.

Kansas City Southern.—Frederick B. De Garmo, who was recently appointed Superintendent at Pittsburgh, Kan., was born in Kentucky in 1867. He went to the State Normal School at

Warrensburg, Mo., and began railroad work in 1880 as a telegraph operator on the Missouri Pacific. He remained on this road and the St. Louis, Iron Mountain & Southern until 1901, serving as despatcher, chief despatcher, Trainmaster and Superintendent. He then went to the Denver & Rio Grande as Assistant Superintendent and in 1905 was made Trainmaster of the Cincinnati, Hamilton & Dayton. During the present year he went to the Kansas City Southern as Trainmaster at Pittsburgh, Kan., where he remained until promoted to be Superintendent at that place.

Kansas City, Mexico & Orient.—Edward Harrison has been appointed Superintendent of the Montana division, with office at Creel, Chihuahua, Mex.

Louisiana Railway & Navigation.—C. L. Vaughn has been appointed Superintendent of Transportation, with office at Shreveport, La.

Midland Valley.—R. Ward has been appointed Trainmaster, with office at Muskogee, Ind. T., succeeding W. J. Weir.

Missouri, Kansas & Texas of Texas.—C. M. Bryant has been appointed Acting Trainmaster of the Fort Worth and Henrietta divisions and of the Sherman and Cleburne branches, succeeding to the duties of J. E. Farrell, assigned temporarily to other duties. J. R. Shaughnessy has been appointed Acting Trainmaster of the Dallas and Denton divisions and of the Bonham branch, succeeding to the duties of George Stoner, assigned temporarily to other duties.

Missouri Pacific.—R. E. Cahill, Superintendent at McGehee, Ark., has been appointed Assistant Superintendent at Kansas City, Mo., succeeding G. W. Inge, resigned to go to another company. T. M. Wallace succeeds Mr. Cahill. W. S. Coffin, chief despatcher at Wynne, Ark., has been appointed Trainmaster at that place, succeeding T. R. Nash, who takes Mr. Coffin's position.

Northern Pacific.—George Theron Slade, who was recently appointed General Manager of the Lines East of Trout Creek, with office at St. Paul, Minn., was born in New York City in 1871. He graduated from Yale College in 1893 and the same year began railroad work as a clerk on the Great Northern. The next year he spent in the track department and in 1895 was appointed chief clerk to a Superintendent. He was made Assistant Superintendent in 1896 and Superintendent in 1897. Two years later he went to the Erie & Wyoming Valley, now part of the Erie, as General Manager, and in 1901 was made General Superintendent of the Erie division of the Erie. In 1903 he returned to the Great Northern as General Superintendent, where he remained until his recent promotion.

Southern Pacific.—The authority of B. A. Campbell, Trainmaster at Sparks, Nev., has been extended to include the territory heretofore in charge of W. J. Stinson, Trainmaster at Winnemucca, Nev., who has been assigned to other duties. Mr. Campbell's territory now extends from Carlin, Nev., to Sparks, and his headquarters are at Winnemucca.

Union Pacific.—W. A. Worthington, whose appointment as Assistant to the Director of Maintenance and Operation of the Union Pacific and the Southern Pacific was announced last week, has been connected throughout his entire railroad career with the latter company. Starting as stenographer and clerk in the office of the Superintendent at Sacramento, Cal., he shortly afterward was made Secretary to the Engineer of Maintenance of Way at San Francisco and three years later became chief clerk. In 1893 he went to the General Manager's office as statistician, and at the end of two years was promoted to chief clerk. He remained in this position until 1901, when he was made executive secretary to the Assistant to the President. In 1894 he was transferred to Chicago as executive secretary and chief clerk to the Director of Maintenance and Operation of the Union Pacific and the Southern Pacific, from which he was advanced to his present position.

Traffic Officers.

Central Vermont.—J. W. Hanley has been appointed General Passenger Agent, with office at St. Albans, Vt., succeeding J. E. Bentley, assigned to other duties.

New York Central Lines.—Carl Howe, Traffic Manager of the Merchants' Despatch Transportation Company, has been appointed Manager of all New York Central fast freight lines except on the New York, Chicago & St. Louis and the Canada Southern.

Engineering and Rolling Stock Officers.

Ann Arbor.—See Detroit, Toledo & Ironton.

Atlanta, Birmingham & Atlantic.—J. E. Cameron, Superintendent of Motive Power, has resigned and the office has been abolished. R. L. Doolittle, Assistant Master Mechanic of the Cen-

tral of Georgia at Macon, Ga., has been appointed Master Mechanic of the Atlanta, Birmingham & Atlantic, with office at Fitzgerald, Ga.

Baltimore & Ohio.—W. I. Rowland, general foreman locomotive department at Grafton, W. Va., has been appointed Master Mechanic at that place, succeeding O. J. Kelly, resigned.

Central of Georgia.—See Atlanta, Birmingham & Atlantic.

Chicago & North-Western.—W. H. Huffman, Master Mechanic at Baraboo, Wis., has retired after 50 years of service on the road.

Detroit River Tunnel.—W. J. Wilgus, formerly Vice-President of the New York Central & Hudson River, has been appointed Consulting Engineer of the Detroit River Tunnel. The peculiar and entirely novel method of construction of this tunnel was designed by Mr. Wilgus and its contract cost is only one-half the amount bid by Sir Weetman Pearson's firm, who are contractors for the Pennsylvania tunnel under the East river, New York City. It is probable that Mr. Wilgus will also act for the New York Central in the construction of the Buffalo union terminal.

Detroit, Toledo & Ironton.—R. Tawse is Superintendent of Motive Power of this road and of the Ann Arbor, with office at Jackson, Ohio.

Georgia Southern & Florida.—W. C. Shaw, Jr., has been appointed Chief Engineer, with office at Macon, Ga., succeeding G. B. Herrington, resigned.

Grand Trunk.—M. Stansfeld Blaiklock, who was recently appointed Engineer of Maintenance of Way, with office at Montreal, Que., was born in Quebec in 1859. He was educated by private tuition under engineers and architects and began railroad work in 1880 as Assistant Engineer on the Grand Trunk. In 1889 he was appointed Assistant Engineer on the St. Clair tunnel construction and two years later was made Inspector of Transportation. In 1897 he was appointed Resident Engineer of the Eastern division. Five years later he was appointed Superintendent of that division, where he remained until his recent promotion.



M. S. Blaiklock.

Midland Valley.—James Carr has been appointed Master Mechanic, with office at Muskogee, Ind. T., succeeding C. H. Welch.

New Orleans Great Northern.—J. F. Coleman, Chief Engineer, has resigned, effective January 1, to become a Consulting Engineer.

New York Central Lines.—See Detroit River Tunnel.

Wisconsin & Michigan.—B. W. Hicks has been appointed Chief Engineer, with office at Peshtigo, Mich.

Purchasing Agents.

Lehigh & New England.—J. B. Whitehead has been appointed Purchasing Agent, with office at Philadelphia, Pa.

LOCOMOTIVE BUILDING.

The Pittsburgh, Shawmut & Northern is said to have ordered 10 freight locomotives and two passenger locomotives.

The Maine Central did not recently order 10 locomotives from the Baldwin Locomotive Works, as reported in the *Railroad Gazette* of November 8.

The Southern denies that it has ordered recently 25 locomotives from the Baldwin Locomotive Works, as reported in the *Railroad Gazette* of November 8.

The Topeka-Southwestern will soon ask for bids on locomotives. Contracts have been let for building the road. W. L. Taylor, Topeka, Kan., is President.

The Pennsylvania has ordered 25 simple, class H6B, consolidation locomotives from the Baldwin Locomotive Works for December,

1907, delivery. These locomotives will be equipped with Walschaert valve gear. The specifications are as follows:

General Dimensions.	
Type of locomotive.....	Consolidation
Weight, total, in working order.....	204,470 lbs.
Weight on drivers.....	181,170 "
Diameter of drivers.....	56 in.
Cylinders.....	22 in. x 28 in.
Boiler, type.....	Belpaire, wide firebox
" working steam pressure.....	205 lbs.
" number of tubes.....	373
" diameter of tubes.....	2 in.
" length of tubes.....	164½ "
Firebox, length.....	107 "
" width.....	66 "
" grate area.....	49.11 sq. ft.
Heating surface, total.....	2,842.4 "
Tank capacity.....	7,000 gals.
Coal capacity.....	27,000 lbs.

John Marsch, Cleveland, Ohio, has ordered six (0-4-0) switching locomotives from the Davenport Locomotive Works for January, 1908, delivery.

General Dimensions.	
Type of locomotive.....	Switching, four-wheel
Weight, total.....	60,000 lbs.
Cylinders.....	15 in. x 20 in.
Diameter of drivers.....	44 in.
Boiler, diameter.....	42½ "
" material.....	Worth steel
" number of tubes.....	160
" material of tubes.....	Detroit seamless
" diameter of tubes.....	2 in.
" length of tubes.....	10 ft.
Firebox, length.....	60 in.
" width.....	34 "
" material.....	Worth steel
Tender.....	Sloping type
Tank capacity.....	2,800 gals.
Coal capacity.....	3½ tons

Special Equipment.	
Air brakes.....	Westinghouse
Bolsters.....	Bettendorf
Couplers.....	Washburn
Injectors.....	Ohio
Lubricators.....	Chicago
Metallic packing.....	Jerome
Springs.....	Pittsburg Spring & Steel Co.
Tender trucks.....	Bettendorf
Tires.....	Midvale

CAR BUILDING.

The Grand Trunk is said to be building four dining cars at its own shops.

The Virginian Railway is preparing specifications on 100 or more coal cars.

The Metropolitan Street Railway, Kansas City, Mo., has ordered 25 city cars from the St. Louis Car Co.

The Chicago & North-Western has asked bids on 1,000 steel ore cars of 100,000 lbs. capacity, the purchase of which has been postponed.

The Atlantic & Western denies that it has ordered 60 box cars from the Lenoir Car Company, as reported in the *Railroad Gazette* of November 8.

The Topeka-Southwestern will soon ask for bids on cars. Contracts have been let for building the road. W. L. Taylor, Topeka, Kan., is President.

The Missouri, Kansas & Texas is said to have canceled contracts for 500 of the 2,000 box cars ordered from the American Car & Foundry Co. last spring.

RAILROAD STRUCTURES.

CLEVELAND, OHIO.—The Cleveland Electric Railway is said to have agreed to construct subways at the public square and to build a high level bridge over the Cuyahoga flats.

DENVER, COLO.—A final conference is soon to be held between the city authorities and the representatives of the railroads regarding plans for the Nineteenth street viaduct, which has been under construction for a number of years. The cost is to be divided among a number of railroads.

EAST STROUDSBURG, PA.—The Delaware, Lackawanna & Western, it is said, will put up a passenger station here 175 ft. long with a 150-ft. platform extension to replace the present structure. The cost will be about \$60,000.

HAGERSTOWN, MD.—The Western Maryland shops at this place have been opened for operation. The locomotive and machine shop building is of brick 150 ft. x 300 ft.

NORFOLK, VA.—The Virginian Railway is building a coal pier at Sewells Point. It is to be 1,000 ft. long and 65 ft. wide. It will be 69 ft. high at the outer end and 75 ft. high at the inner end. The sub-structure is to be concrete, on piling. The steel superstructure will be 1,045 ft. long between the bulkhead and pierhead. There will be three tracks on the pier and 31 chutes with pockets of 60 tons capacity.

ROCHESTER, N. Y.—Contract is reported let to J. W. Dwyer, of Buffalo, at \$100,000, for constructing a subway under the New York Central tracks at Culver road.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ALABAMA & NORTHWESTERN.—Rights-of-way, it is said, are now being secured by this company for its proposed line from Gadsden, Ala., northwest to Tusculum, 120 miles. S. E. Gardner, President, Landersville; J. B. Sherill, Chief Engineer, Falkville.

AMERICAN RAILROAD OF PORTO RICO.—This company, which early this year finished its line from the western end of the line on the north coast at Camuy west and thence south to Aguadilla, 27 miles to a connection with the line south along the west coast, is now running trains through from San Juan to Ponce. (April 12, p. 531.)

CANADIAN PACIFIC.—On the Central division a new route has been opened from Molson, Man., west via Hazel Ridge to Whittier Junction, 36.7 miles. Trains between Fort William, Kenora and Winnipeg are now run over the new line.

An extension has been opened on the Pheasant Hills branch from Strassburg, Assn., west to Nokomis, 31.2 miles.

CATAWBA VALLEY.—See Seaboard Air Line.

CENTRALIA EASTERN.—Bids, it is said, are being asked for by a company under this name to grade its proposed line in the state of Washington from the coal mines of the Mendota Coal & Coke Company to the Northern Pacific, near Centralia, about 10 miles.

CENTRAL OF OREGON.—This company is building from Union, Ore., northwest to La Grande, 45 miles. It has opened the road for business from Union Junction to Valley Junction, 1.5 miles, and from Valley Junction to Cove, 10.5 miles. (March 29, p. 467.)

CENTRAL ONTARIO RAILWAY.—Bids are wanted by this company December 2, at Trenton, Ont., for clearing, grading, track laying, ballasting and other work on its extension between Lake St. Peter and Whitney, about 18 miles. The road is now in operation from Picton, Ont., north to Bancroft, 116 miles, from which point an extension is being built north to Whitney, 43 miles. Contracts for some of this work have been let to William G. Gibson, of Port Hope, Ont. Grading work has been finished on 14½ miles and track laid on four miles. (March 15, p. 395.)

CHICAGO, BURLINGTON & QUINCY.—An ordinance, it is said, will be passed by the Hannibal (Mo.) city authorities, granting permission to this company to lay a double-track line along the river front. The company is to reconstruct and extend its yards at this place, and a union passenger station may also be put up.

CHICAGO, ROCK ISLAND & PACIFIC.—This company, it is said, has work under way at El Reno, Okla., involving the handling of 500,000 cubic yards of earth raising the grades from 3 ft. to 7 ft. on a plot of ground 600 ft. x 7,000 ft. as a site for freight yards. There are to be 24 freight tracks each 7,000 ft. long.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA.—The extension of the Nebraska division from Newcastle, Neb., to Wynot, 18.3 miles, was opened for traffic on October 28. (Sept. 27, p. 370.)

COPPER RIVER & NORTHWESTERN.—Contracts are reported let by this company to M. J. Heney for some of the work on its proposed line from Cordova, Alaska, north to the Copper river, thence along that river. It is said the company will spend \$25,000,000 in building the line and adding a large smelter at tidewater. (April 26, p. 599.)

DALLAS INTERURBAN (ELECTRIC).—This company, it is said, will soon start work on its proposed electric line from Dallas, Tex., east via Mesquite and Forney to Terrell, 30 miles. The company also proposes to build a line from Dallas south to Waxahachie, 30 miles. D. E. Waggoner is President. (Oct. 25, p. 509.)

GREAT NORTHERN.—It is announced that the Spokane Falls & Northern, building in the United States under the name of the Washington & Great Northern, has been opened for freight traffic to a point north of Chopaka, Wash., and across the international boundary into Canada, where the line is being built under the name of the Vancouver, Victoria & Eastern to Keremeos, B. C., 15 miles north of its junction with the Washington & Great Northern, and 122 miles west of Grand Forks, B. C. The line is eventually to be extended west to Vancouver and east to Winnipeg. Contracts let from Keremeos northwest to Princeton, 45 miles.

GREENVILLE & KNOXVILLE.—This road has been extended from Travelers Rest, S. C., north to Marietta, six miles. (Sept. 6, p. 277.)

JEFFERSON CITY, ALBUQUERQUE & SAN DIEGO VALLEY.—Incorporated in Oklahoma with \$7,000,000 capital and office at Carthage, Mo. The company proposes to build a line from Jefferson City, Mo., southwest through Missouri, Kansas, Oklahoma, New Mexico

and Arizona to San Diego, Cal., 1,600 miles. The incorporators include: J. H. Langston, J. H. Harris and O. S. J. Guymon, of Carthage; C. R. Wright, Liberal, Kan., and W. F. Bort, Wichita, Kan.

LIMA & TOLEDO TRACTION.—This company, building an extension from Leipsic, Ohio, north to Toledo, 40 miles, has grading about finished and track laid on 32 miles. It is said that work is to be suspended, with the exception of finishing the reinforced concrete bridge over the Maumee river at Waterville, until next spring, when the line is to be finished to Toledo. (March 15, p. 386.)

MEXICAN CENTRAL.—This company, it is said, has adopted plans for extensive terminals at the new port of Arias, nine miles north of Tampico.

MEXICO, SANTA FE & PERRY TRACTION.—Work is reported under way and contract let to J. M. Wolf, of Collinsville, Ill., for building this proposed electric line from Mexico, Mo., northeast via Molino and Santa Fe to Perry, 27 miles. S. L. Robinson, President, Mexico, and C. O. Thon, Chief Engineer, Brileville. (May 24, p. 727.)

MISSOURI ROADS (ELECTRIC).—The Chippewa Valley Construction Co., of Ashland, Wis., will, it is said, build next spring an inter-urban electric line from Ashland north to Washburn, ten miles. About one-third of the right-of-way has been secured.

MORGAN'S LOUISIANA & TEXAS.—See Southern Pacific.

NORFOLK & SOUTHERN.—The Raleigh division of this road has been extended from Zebulan, N. C., east to Farmville, 48 miles. This entire division is now finished and open for traffic from Raleigh, N. C., east to Washington, 105.3 miles. (July 19, p. 83.)

NORFOLK & WESTERN.—On the Radford division, the Speedwell branch has been extended from Cripple Creek, Va., west to Speedwell, seven miles.

The Dry Fork branch on the Pocahontas division has been extended from Berwind, W. Va., southeast to Canebreak, 2.3 miles. (Sept. 20, p. 339.)

NORTHERN PACIFIC.—President H. Elliott, of this company, is quoted as saying that in Washington and Montana construction work is to be continued; but in Wisconsin and Minnesota the forces will be reduced.

OREGON & WASHINGTON.—See Oregon Railroad & Navigation Company.

OREGON RAILROAD & NAVIGATION COMPANY.—Bids are reported asked for this week for work on the Oregon & Washington between Portland, Ore., and Seattle. The work includes many trestles and bridges and a long tunnel. (July 19, p. 83.)

OREGON TRUNK LINE.—Preliminary surveys, it is said, are being made by this company for its proposed line from The Dalles, Ore., south through the canyon of the Deschutes river, about 125 miles. Work on the line is to be begun early next year. W. S. Nelson, President, and F. S. Gordon, Chief Engineer, Seattle, Wash. (Aug. 9, p. 164.)

PITTSBURGH RAILWAYS COMPANY (ELECTRIC).—Work has been resumed on the Canonsburg branch of this road. It was stopped some months ago because of difficulties in securing the right-of-way. It is from Finleyville, Pa., on the Charleroi division, west to Canonsburg, about 12 miles, to a connection with the company's line running south from that place to Washington. Almost all of the line will be over a private right-of-way, and the company plans to run express trains from Pittsburgh to Washington, whence connection may be made with an electric line now partly built to Wheeling, W. Va. The company is also considering the double-tracking of the entire Charleroi division. The line has double-track bridges and all of the cuts and fills are wide enough for second track. During the year the company has lengthened many of the sidings on this division.

PLANT CITY, ARCADIA & GULF.—See Seaboard Air Line.

QUEBEC & LAKE ST. JOHN.—The branch from La Tuque Junction, Que., west to La Tuque, 38.6 miles, has been opened for business. (Oct. 11, p. 435.)

A new line called the Gosford branch has been opened for business from Valcartire Junction, Que., (formerly Valcartire) northwest to Clarks, 5.5 miles.

RED RIVER (ELECTRIC).—Incorporated in Oklahoma with \$5,000,000 capital, and offices at Oklahoma City and at Durant, the company proposes to build an electric line from a point in Oklahoma at the Texas-Oklahoma state line north of Bonham, Texas, northwest to Oklahoma City, about 200 miles. The incorporators include: E. M. Abernathy, S. C. Hawk and F. J. Hawk, of Lexington; D. F. Robertson, of Atoka; F. P. Kibbey, of Byers; J. W. Hocker, of Purcell; A. Rennie, of Pauls Valley, and T. H. Bayless, of Durant.

ROBERT LEE & FORT CHADBOURNE.—Grading work is reported under way by E. Hunter, of Robert Lee, who has the contract for 30 miles of this proposed line from Robert Lee, in Coke county, Tex.,

northeast towards Fort Chadbourne. The line is projected east to Winter, about 50 miles. J. H. Spencer, President, and S. J. Bross, Chief Engineer, Robert Lee. (Sept. 27, p. 371.)

SEABOARD AIR LINE.—A new line, the Catawba Valley, has been opened for business from Spence, S. C., south to Great Falls, 21 miles.

The Plant City, Arcadia & Gulf has been opened for business from Plant City, Fla., south to Nichols, 16 miles.

SOUTHERN PACIFIC.—Tracklaying has begun on the extension of Morgan's Louisiana & Texas from Lafayette, La., which is 145 miles west of New Orleans, east to the west bank of the Mississippi river opposite Baton Rouge, 53 miles. By cutting out the long detour southward to New Orleans this line saves 180 miles on through shipments. The most difficult part of the work was over the Atchafalaya swamp, where it was necessary to construct 12 miles of trestles. This will be filled in as soon as rails are laid to the eastern boundary of the swamp. The Atchafalaya river is crossed by a 450-ft. truss bridge. From Lafayette the extension passes through the Anse La Butte oil country and the Grand Point Prairie, a fertile cotton section. Between the swamp section and the Mississippi the line traverses about eight miles of valuable hard timber land. At the river there will be a passenger and freight ferry to Baton Rouge. (Jan. 7, p. 819.)

SPOKANE FALLS & GREAT NORTHERN.—See Great Northern.

TEXAS ROADS.—It is said that preliminary plans are being made by residents of Denton, Tex., and Krum to build a line to connect these two places, which are five miles apart. C. B. Duffy, of Boston, Tex., is said to be the principal promoter.

TEXAS ROADS (ELECTRIC).—Residents of Greenville, Wolfe City and Bonham are organizing to build an electric line to connect these places. The length would be about 35 miles. J. C. Russell, of Bonham; J. H. Blocker, of Wolfe City; J. T. Jones, G. H. Collins and Y. O. McAdams, of Greenville, are interested.

TONOPAH & TIDEWATER.—This road is now in operation from Ludlow, Cal., north to Leeland, Nev., 144 miles; also from Death Valley Junction, Cal., west to Lila C. It is reported that regular freight service is to be extended north to Beatty, Nev., and to Rhyolite November 25, and passenger service is to be started about December 1. (Sept. 6, p. 278.)

TULSA-SAPULPA INTERURBAN.—Residents of Tulsa, Okla., have applied for authority to build this line from Sapulpa northeast to Tulsa, 20 miles, with a connection to the Glenn oil fields. They propose to begin work at once and expect ultimately to extend the line east through Broken Arrow to Muskogee.

UNION PACIFIC.—At the offices of this company in Omaha, Neb., the report that construction work on this system has been abandoned is denied. Vice-President A. L. Mohler is quoted as saying that there is much unnecessary sensation over the reduction in track forces which always takes place at this season of the year on account of the shorter hours and cold weather. "We have been making a large amount of improvements and have put our property in the best physical condition it has ever known, and the opportunity for reducing forces earlier than usual has been acted upon. We are continuing all improvement work which can be done to advantage and which we can utilize. Work which cannot be carried on at normal expense will be discontinued."

VANCOUVER, VICTORIA & EASTERN.—See Great Northern.

WASHINGTON & GREAT NORTHERN.—See Great Northern.

WEST TEXAS & NORTHERN.—This company, which has projected a line from Stanton, Tex., north to Hereford, 225 miles, is said to have given contracts for building the first 75 miles from Stanton north to Tahoka. S. G. Bon Durant, of New York, is said to be promoting this project.

WOODSTOCK, MARENGO, GENOA & SYCAMORE (ELECTRIC).—Incorporated in Illinois with \$25,000 capital and office at Chicago, the company proposes to build an electric line from Woodstock, Ill., southwest through McHenry and De Kalb counties to Sycamore, 30 miles. The incorporators include: C. A. Spennay, M. W. Powell, E. B. Horang and H. S. Hedberg.

RAILROAD CORPORATION NEWS.

CHICAGO JUNCTION.—See Indiana Harbor Belt.

CONNECTICUT RAILWAY & LIGHTING COMPANY.—See New York, New Haven & Hartford.

CONSOLIDATED RAILWAY.—See New York, New Haven & Hartford.

DENVER & INTERMOUNTAIN.—See Intermountain Railway.

HOCKING VALLEY.—See Kanawha & Michigan.

ILLINOIS CENTRAL.—Arguments are to be heard on November 25 on the question of the voting of 5,500 shares of Illinois Central

stock held by the Mutual Life Insurance Company, New York. These shares are among those whose voting rights were enjoined just before the annual meeting last month.

President Harahan has sent to stockholders a circular letter, in which he answers criticisms which have been made of the management. In reference to Stuyvesant Fish's statement that exclusive traffic alliances with east and west connecting roads are undesirable, President Harahan says that the Union Pacific and the Southern Pacific have, during the past six years, delivered to the Illinois Central 46 per cent. more tonnage than they received from it; that these two roads are the only lines of those connecting with the Illinois Central which do not own eastern outlets, and that the Illinois Central has to compete with other eastern roads for this Union Pacific and Southern Pacific traffic.

INDIANA HARBOR BELT.—This company has made a mortgage to the Guarantee Trust Company, New York, as trustee, securing an issue of \$25,000,000 50-year 5 per cent. general mortgage bonds. It is understood that plans are under way for making the Indiana Harbor Belt the owner of all New York Central terminals in and near Chicago. It is said to have bought the Chicago Junction Railway's belt line around Chicago from Whiting, Ind., to Franklin Park, Ill., 27 miles. This does not include the branch from Chappell, Ill., to the union stock yards. An option of the property was taken by New York Central interests last June. (June 28, p. 949.)

INTERMOUNTAIN RAILWAY.—This company has been incorporated, with \$1,000,000 capital stock to take over the Denver & Intermountain and electrify it from Barnum, Colo., to Golden, seven miles. The five miles of road from Denver to Barnum are already operated by electricity.

KANAWHA & MICHIGAN.—It is said that arrangements have been made for issuing \$2,000,000 of the \$2,500,000 second mortgage, 20-year 5 per cent. bonds authorized last June. Part of the proceeds are to be used to pay off \$1,800,000 floating debt, of which \$1,600,000 is due the Hocking Valley and \$200,000 due to the Toledo & Ohio Central.

NEW ENGLAND INVESTMENT & SECURITY CO.—See New York, New Haven & Hartford.

NEW YORK, NEW HAVEN & HARTFORD.—The Directors have decided to issue about \$40,000,000 6 per cent. convertible 50-year debenture bonds instead of new capital stock. The debentures will be convertible into stock after January 15, 1923, at the rate of one share of stock for each \$100 face value in debentures. The debentures are to be offered to stockholders of record December 2, 1907, for subscription at par up to January 15, 1908, at the rate of \$100 in debentures for every three shares of stock already held. The subscriptions are payable in four instalments, falling due January 15, 1908, and at six months intervals thereafter. The proceeds of the debentures, it is understood, will pay for improvements amounting to \$17,000,000 and \$21,000,000 worth of new equipment. (Nov. 8, p. 574.)

The regular quarterly dividends of 1 per cent. on the \$8,142,900 4 per cent. cumulative preferred stock, 1 per cent. on the assenting common stock and 0.15 per cent. on the non-assenting common stock of the Connecticut Railway & Lighting Co. have been declared. The company was leased in August, 1906, to the Consolidated Railway, which has since been merged with the New York, New Haven & Hartford. The majority of the common stockholders agreed to pay the Colonial Trust Company, as Trustee, \$10 a share on their stock, which amount, with the rental received under the lease, provides a fund for dividend payments on both common and preferred stock.

President Mellen has retired from the Presidency of the Springfield (Mass.) Street Railway, and it is said that he will also resign from offices in other electric railway companies in Massachusetts which are controlled by the New England Investment & Security Co., a subsidiary of the New York, New Haven & Hartford.

NORTH AMERICAN COMPANY.—The directors have announced that payment of the usual quarterly dividend of 1 per cent. on the \$29,791,300 capital stock will be postponed. The company controls street railways and other electric properties in and near St. Louis, Mo.; Milwaukee, Wis.; Cincinnati, Ohio; Detroit, Mich., and other cities. It has made loans amounting to over \$3,600,000 to subsidiary companies for improvements and extensions, and these companies cannot repay these loans without selling at large sacrifice their own mortgage bonds; therefore, the North American Company is for the present short of ready money.

SOUTHERN.—This company has asked the New York Stock Exchange to list \$1,964,000 additional first consolidated 5 per cent. bonds and \$300,000 additional Memphis division first mortgage 5 per cent. bonds, making the total amounts listed \$50,101,000 consolidated and \$6,883,000 Memphis division bonds.

TOLEDO & OHIO CENTRAL.—See Kanawha & Michigan.